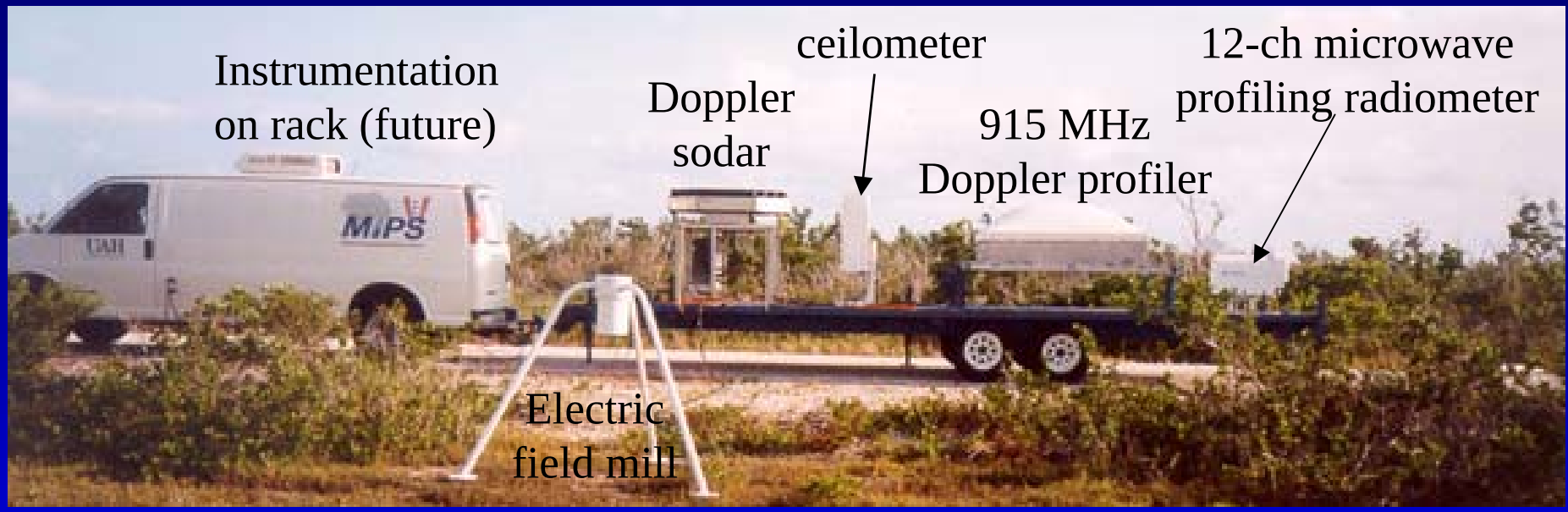
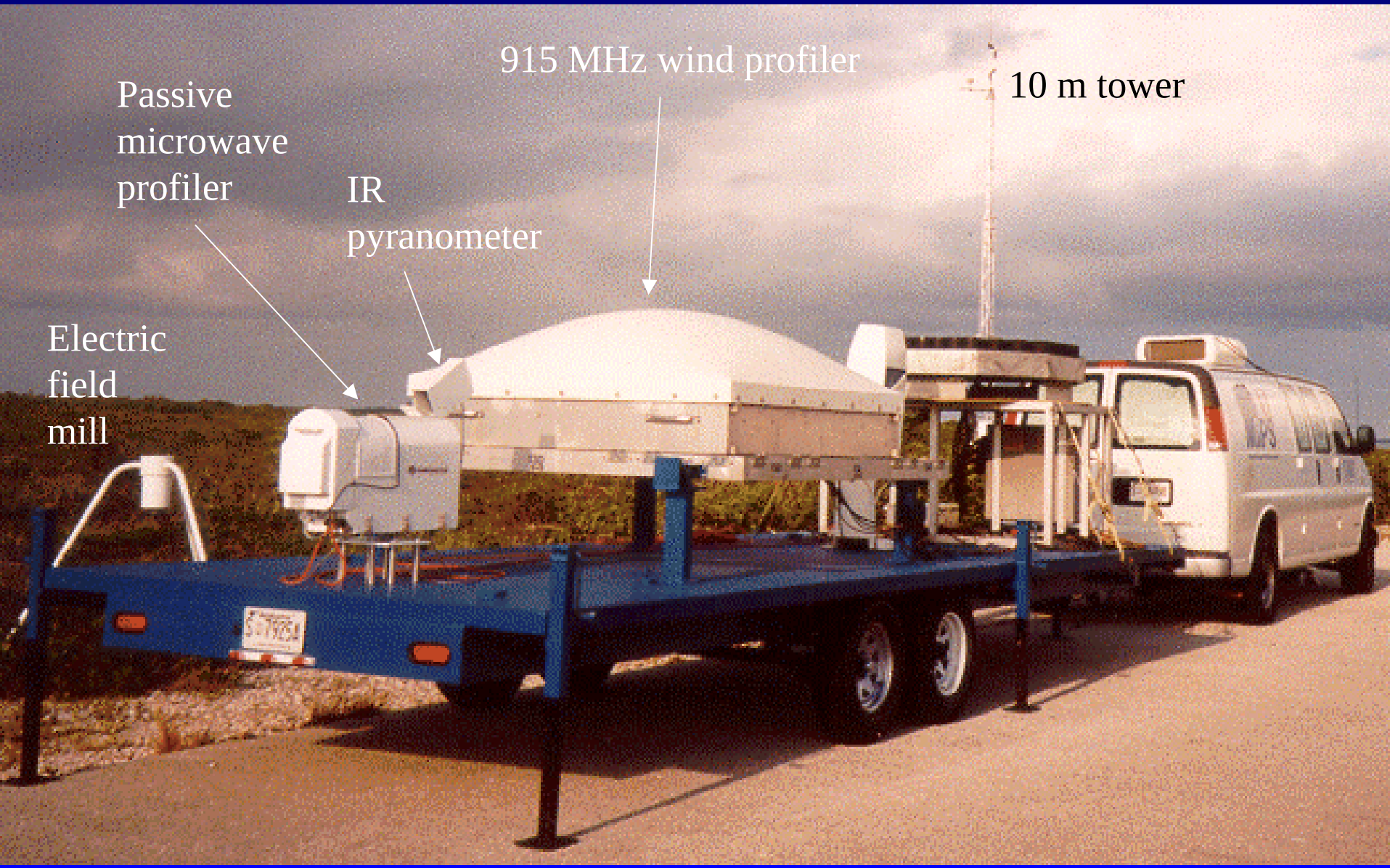
General Science Objectives

- Observational documentation of the ***boundary layer properties*** in landfalling tropical storms and cyclones
  - Intensity change and wind diagnosis applications
- Improved understanding of ***precipitation processes*** and properties
  - QPE applications
- Latent heating processes (BL thermodynamics)
  - impact of precipitation evaporation and downdraft transports on the BL in TS/ TC; boundaries
- Ground/observational ***validation***

MIPS measurement capabilities (CAMEX/KAMP)



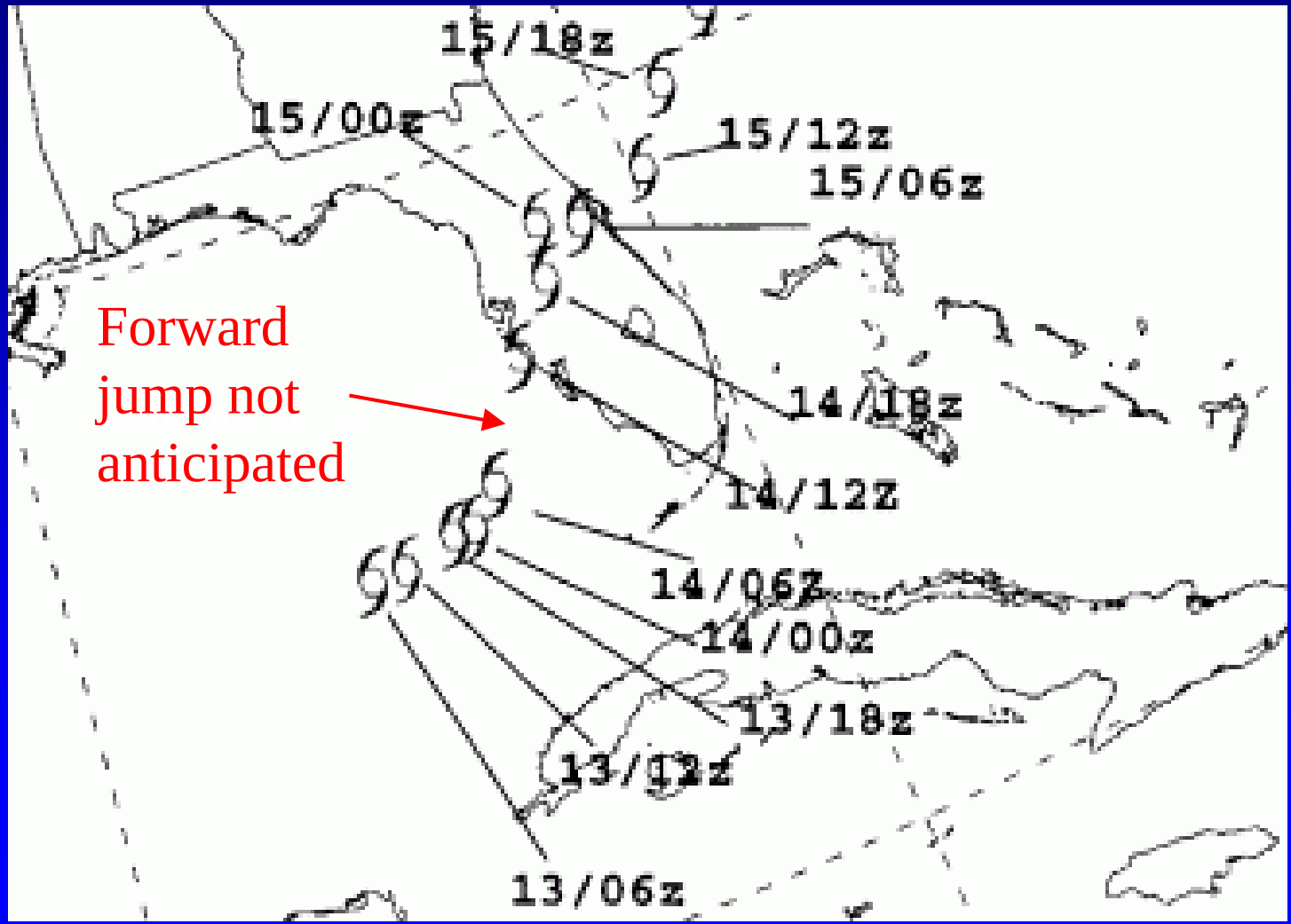
Instrument and measured parameter	*Δt, Δz, height coverage*
• 915: $V_h(z)$, $w(z)$, $C_n^2(z)$	60 s, 105 m 0.1 to 2-4 km
• sodar: $V_h(z)$, $w(z)$, $C_T^2(z)$	18 s, 25 m, 50 to 200-400 m
• ceilometer: $\beta(z)$, cloud base	15 s, 15 m, 15 to 7600 m
• MPR: $T(z)$, $r_v(z)$, $r_c(z)$, integrated vapor & liquid	15 min, variable, 0.1-10 km


915 MHz wind profiler
10 m tower
Passive microwave profiler
IR pyranometer
Electric field mill

Landfall of TS Gabrielle

- MIPS set up near Venice, FL
- Co-location with mobile C-band Doppler radar (SMART-R)
- Center of circulation and developing “eye” passed over MIPS & S-R
- Jump in forward speed precluded CAMEX-4 overflights at landfall

Gabrielle path, 0600 11/13 to 1800 11/15
Intensity near TC strength at landfall

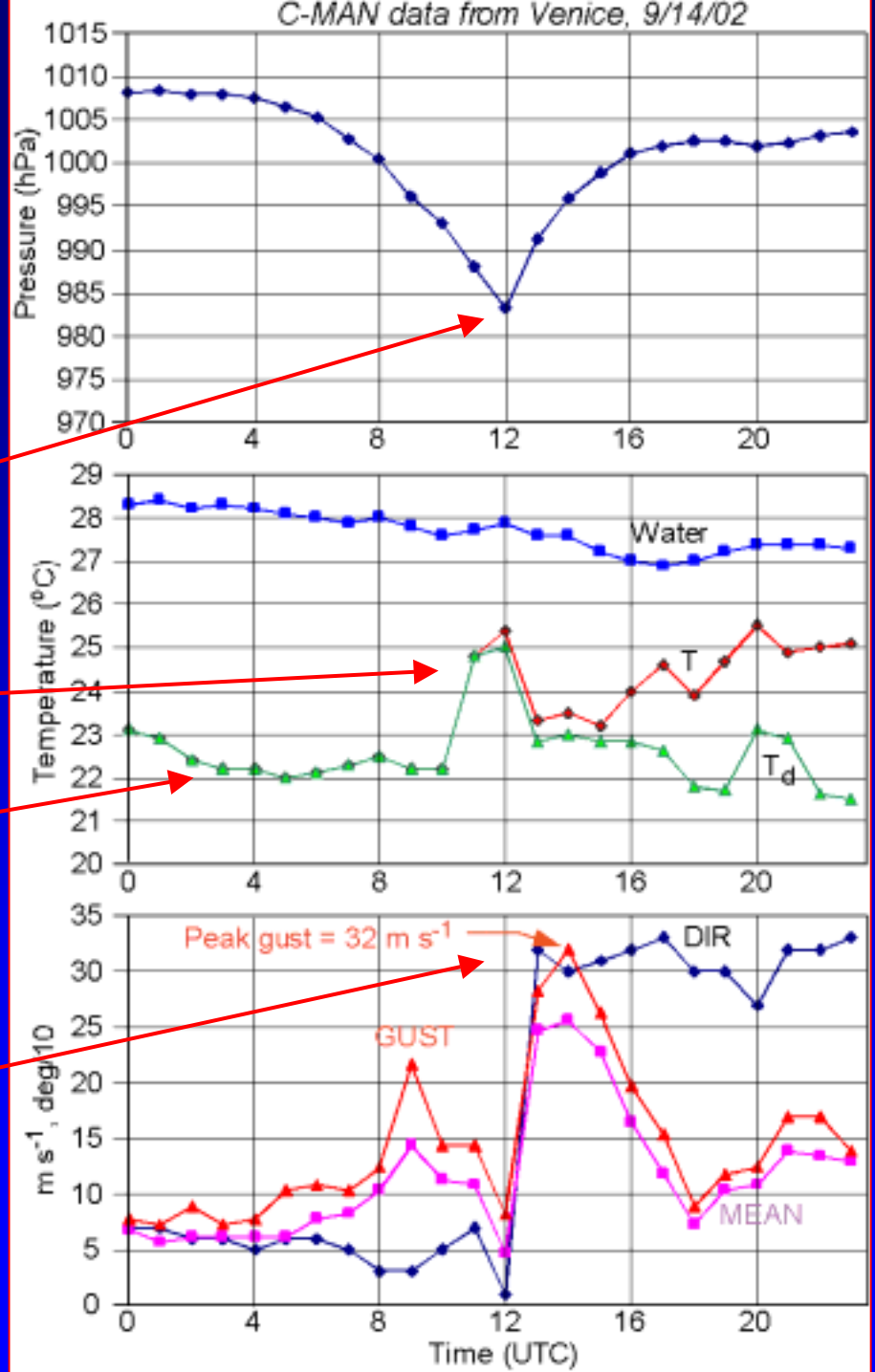


Some interesting features

- Electrification properties (electric field), and CG lightning behavior
- Bright band variation
- Wave motions in upper troposphere near circulation center,
- Gravity waves in convective region
- Boundary layer variation
- Wind profiles - fetch off land and water
- Eye formation
- Frontal boundary and baroclinic features

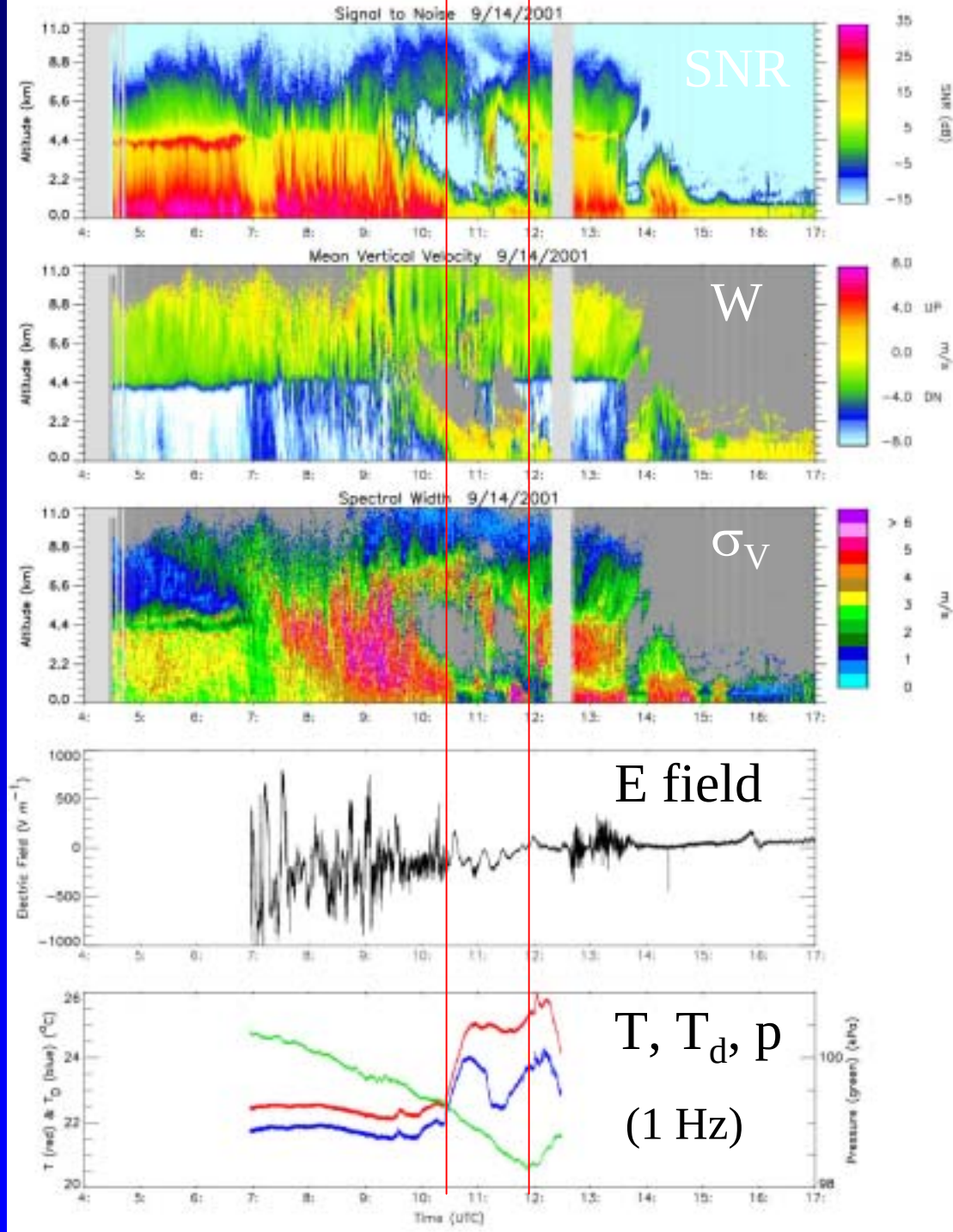
Landfall overview, VENF1 C-MAN

- Minimum p of 983 mb at 1200 UTC 9/14
- Boundary passage near 1000 UTC
- Cold air over land (22 ºC)
- Peak wind gust 32 m/s on W side after eye passage

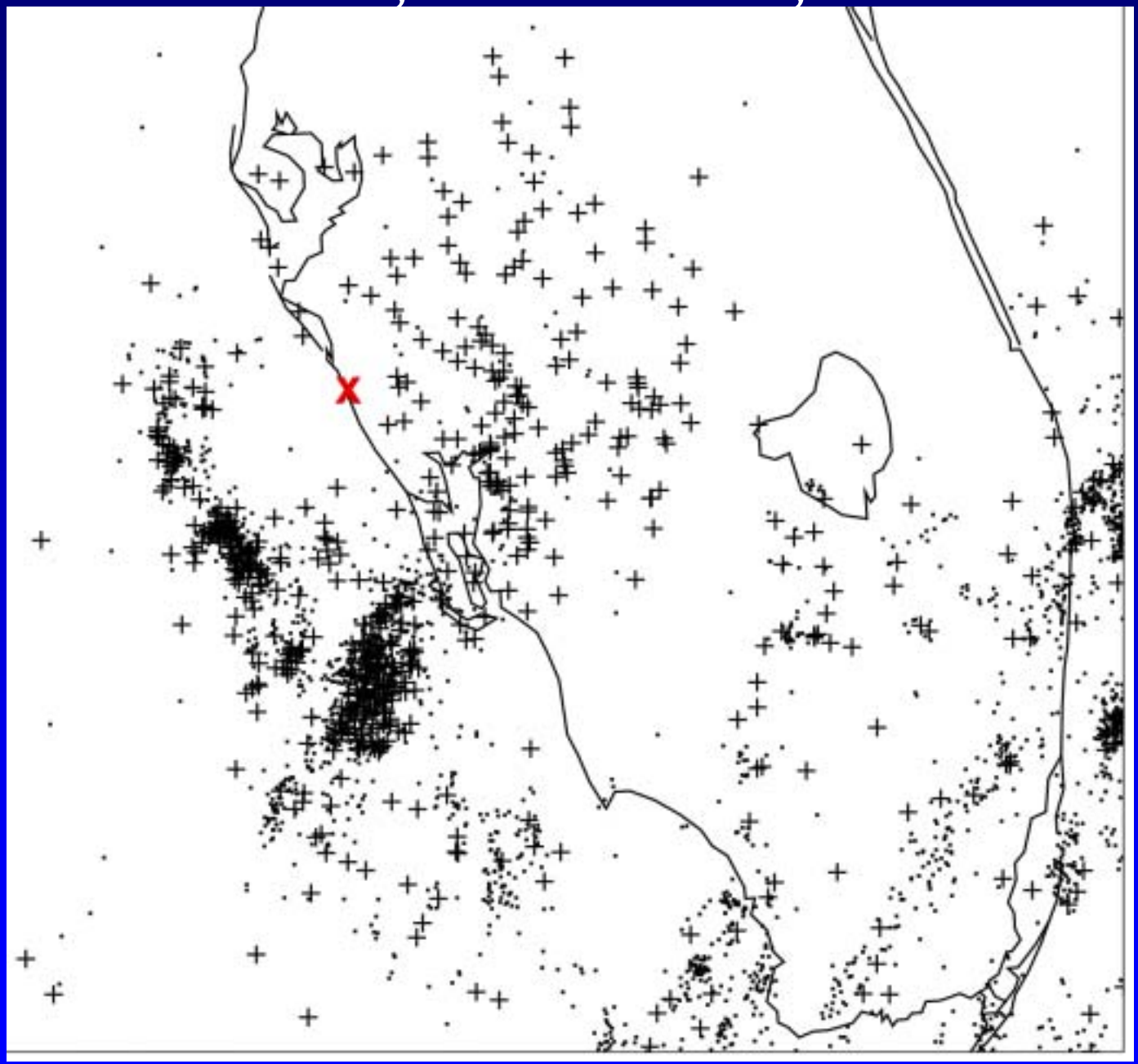


MIPS 915 MHz data 4-16 UTC 9/14/01

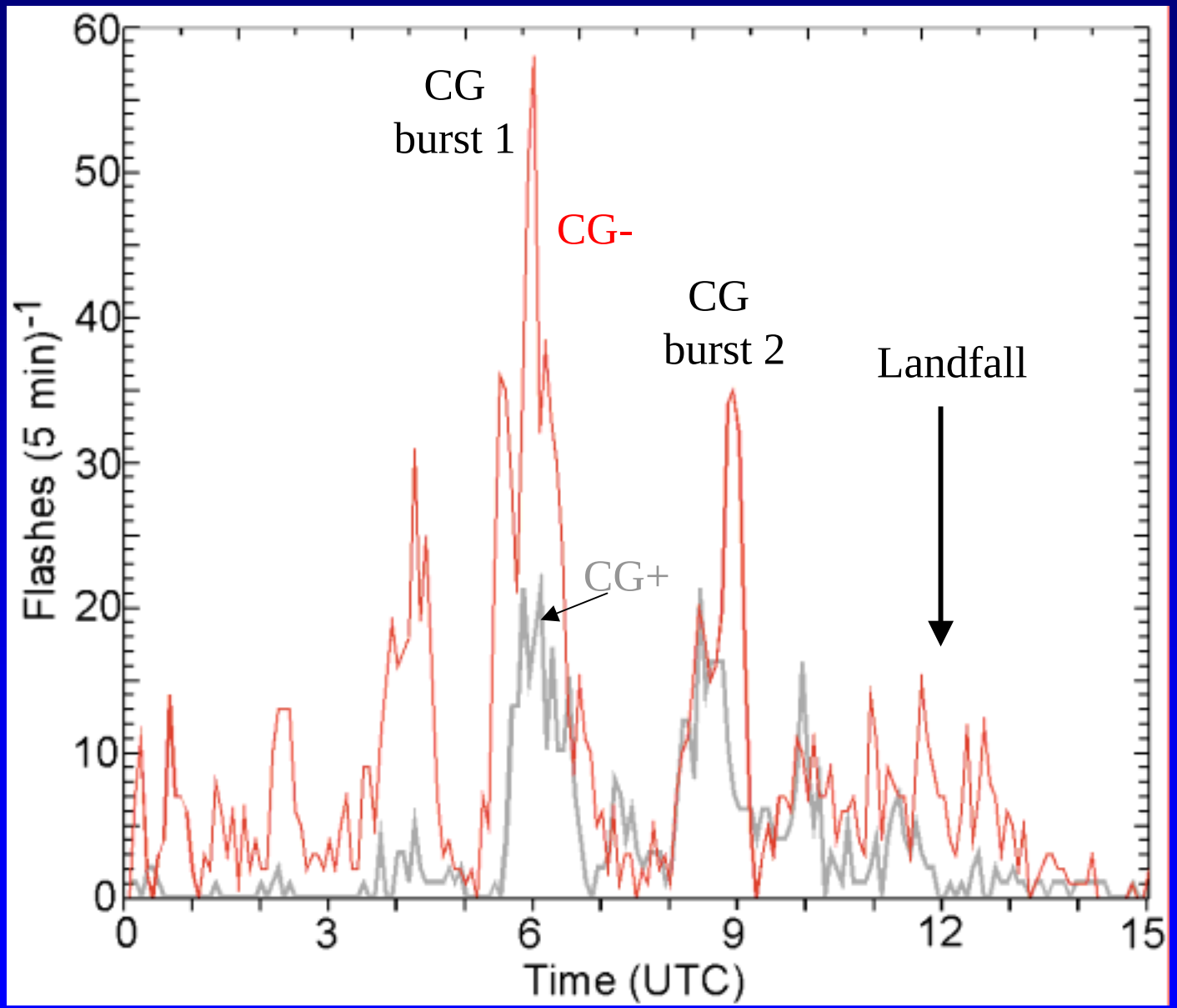
- 915 MHz spectral moments (zenith)
  - SNR
  - W
  - spectrum width
- E field
  - abundant lightning
- Surface thermo.
  - "frontal" passage



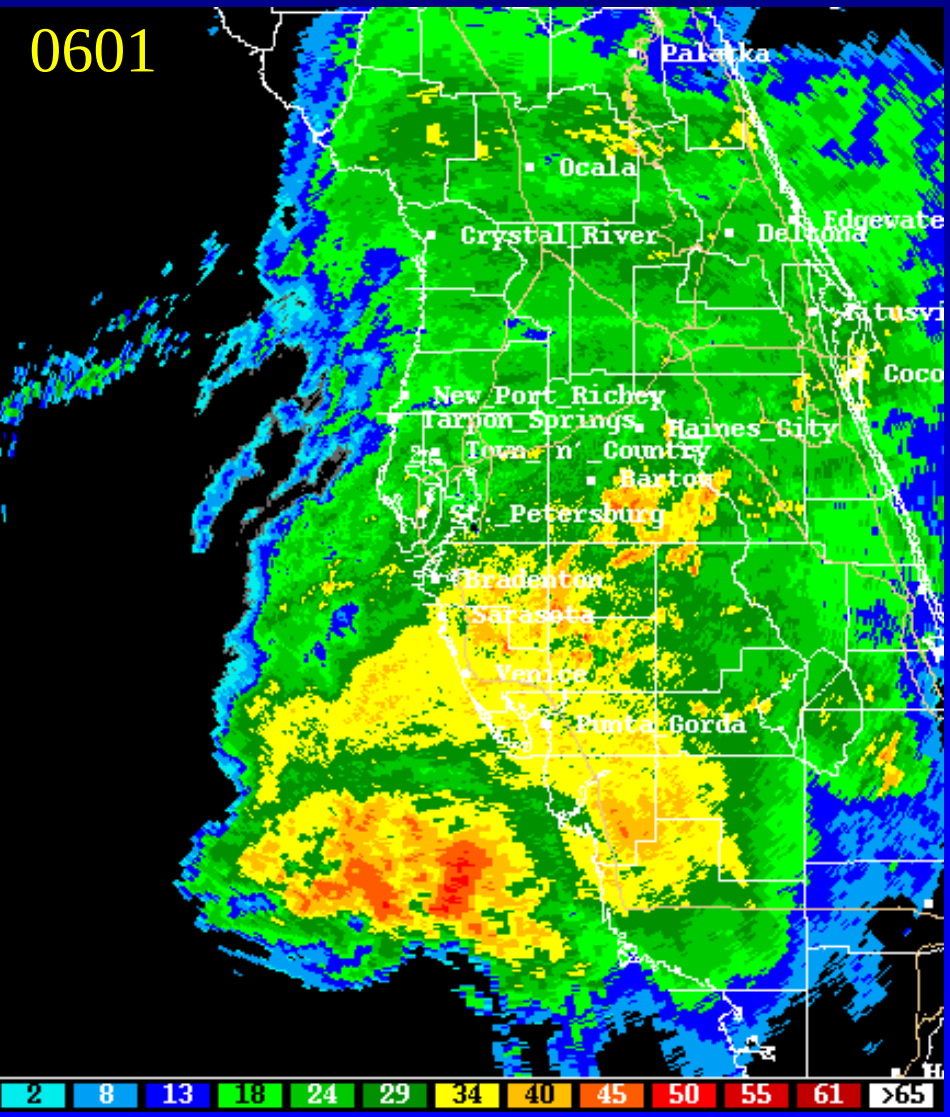
CG flashes, 00-15 UTC, 9/14/02

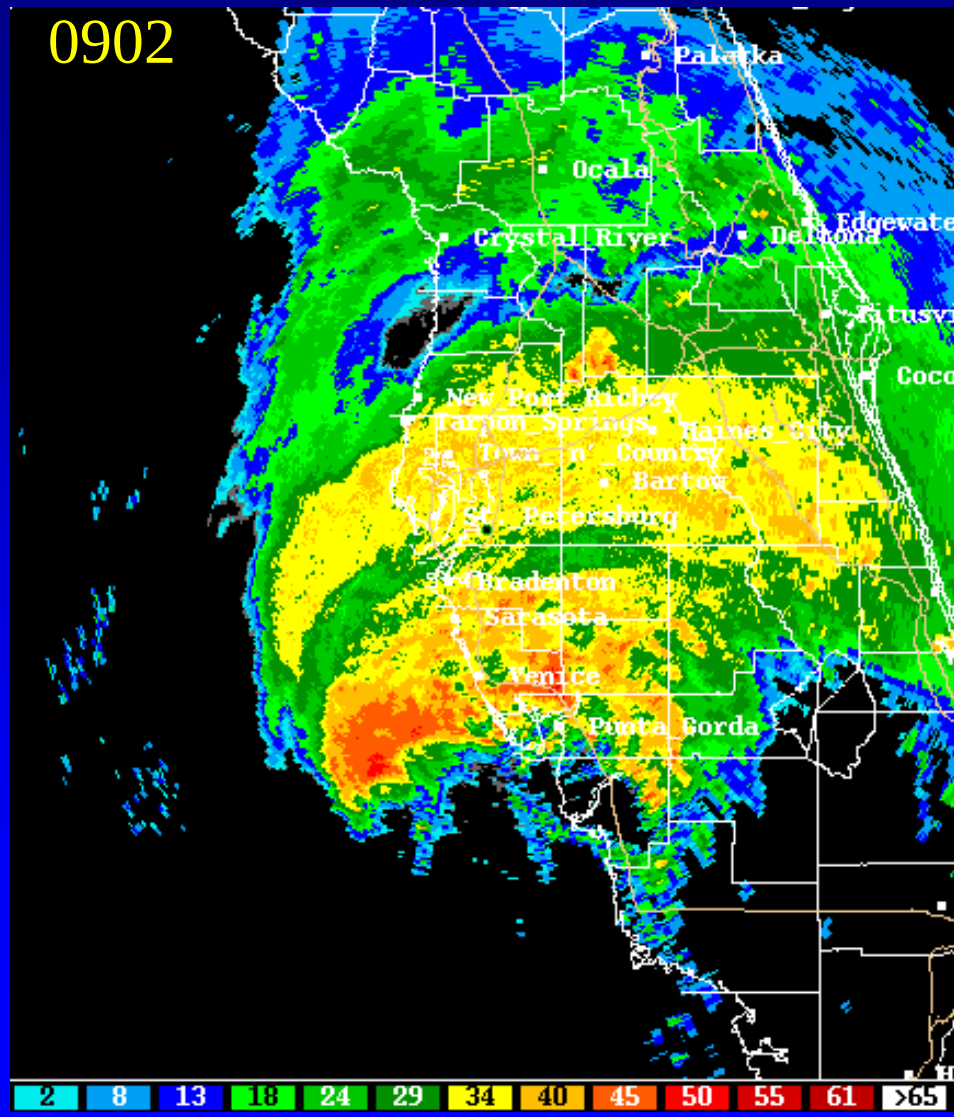


CG time series, 00-15 UTC, 9/14/01

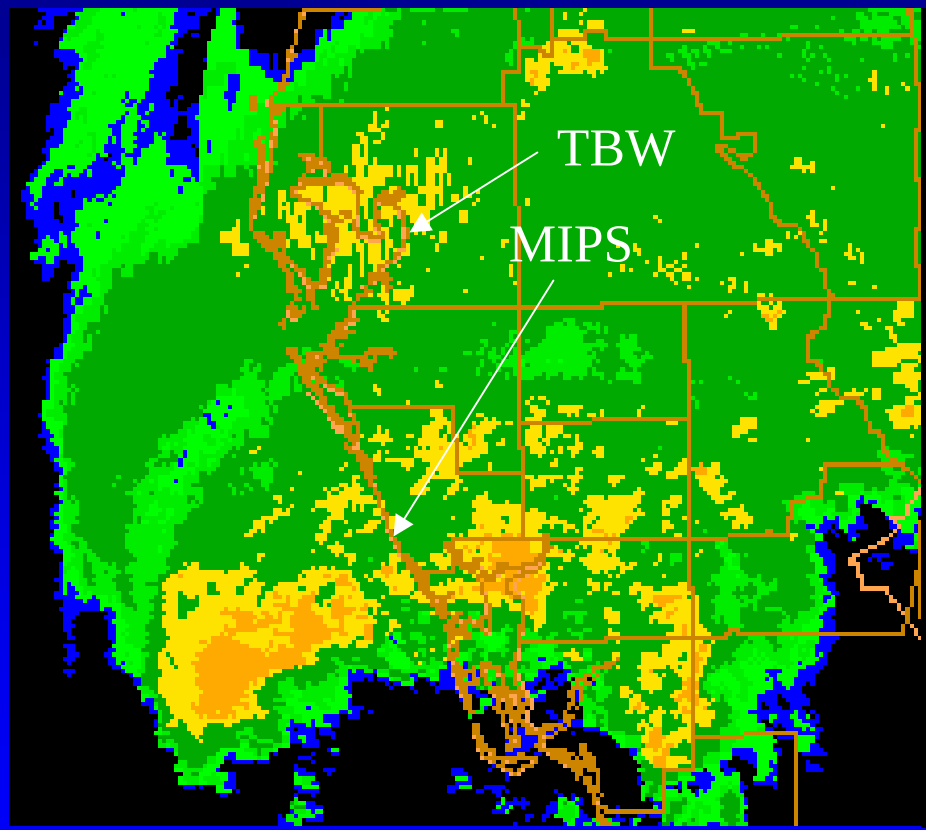


CG bursts are associated with northern "eyewall" intensification

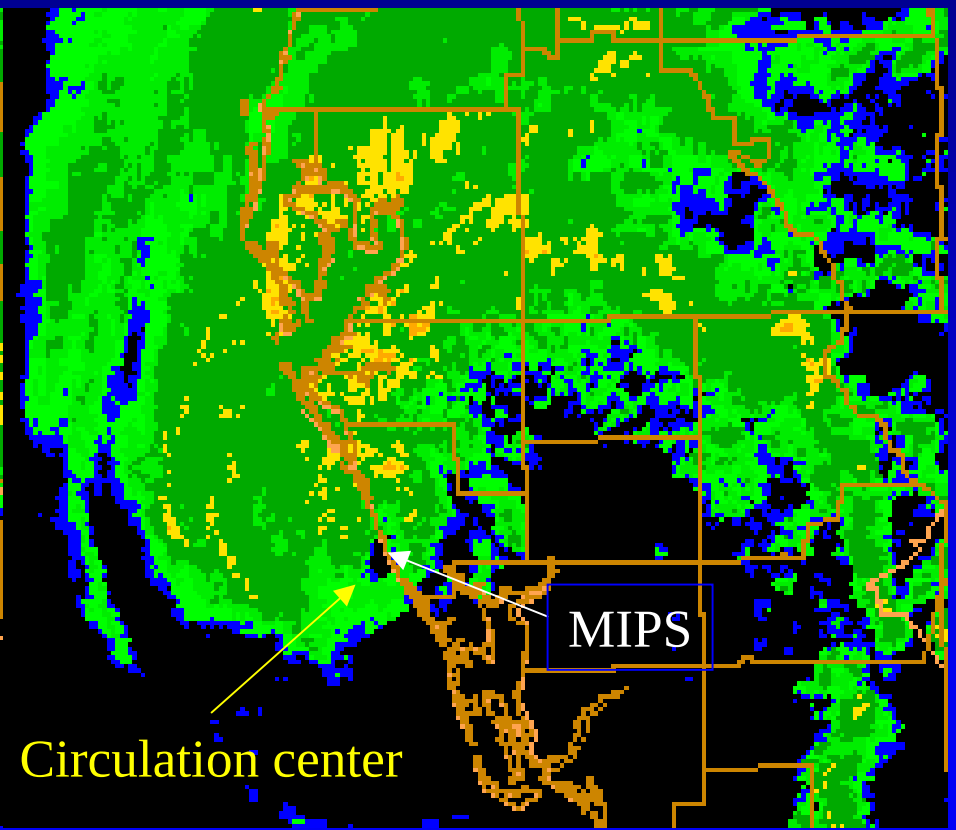




TBW reflectivity factor: “eye” formation during landfall of Gabrielle (Note the intrusion of dry air east of the center)

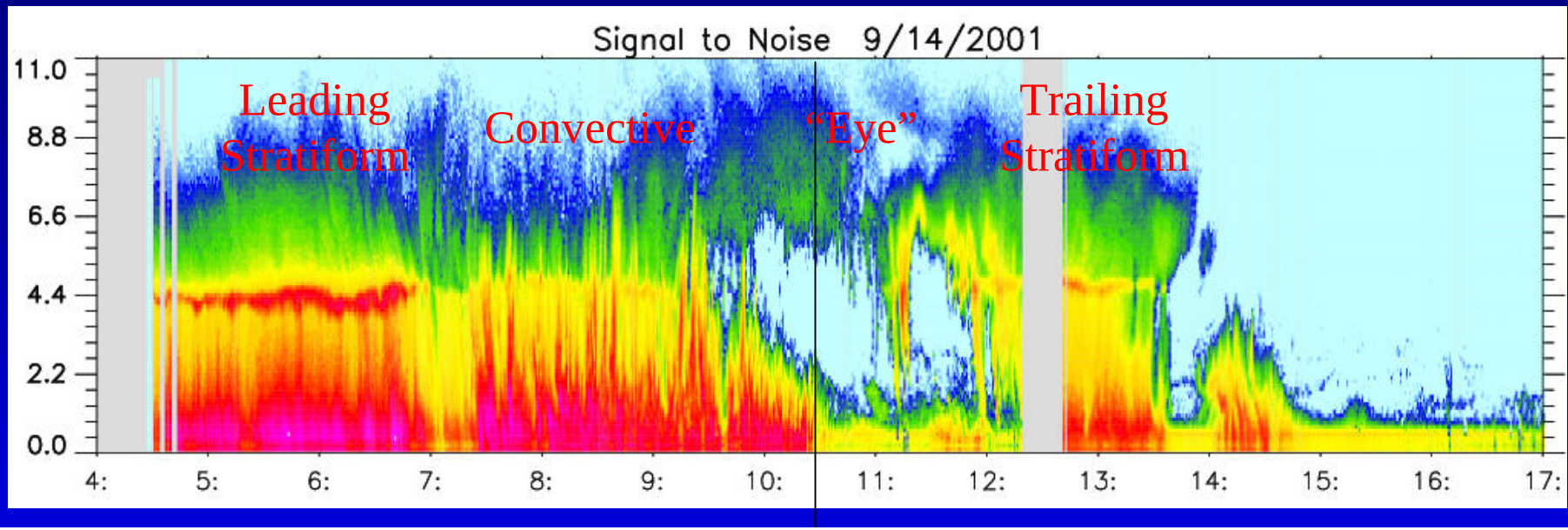


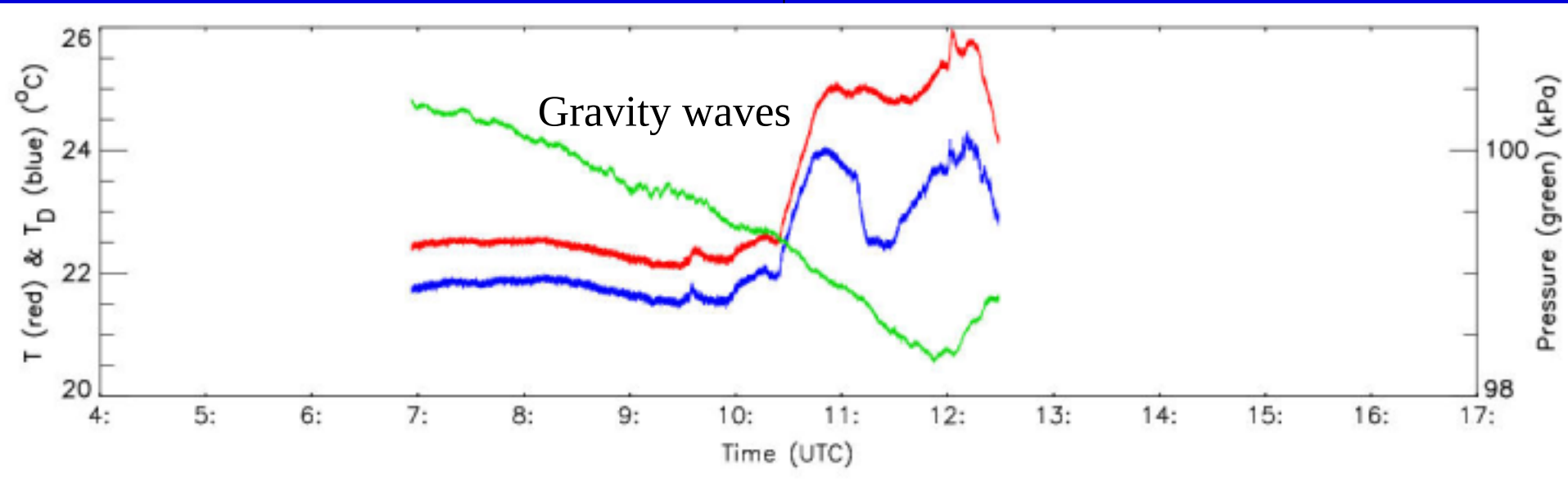
TBW, 0901 UTC



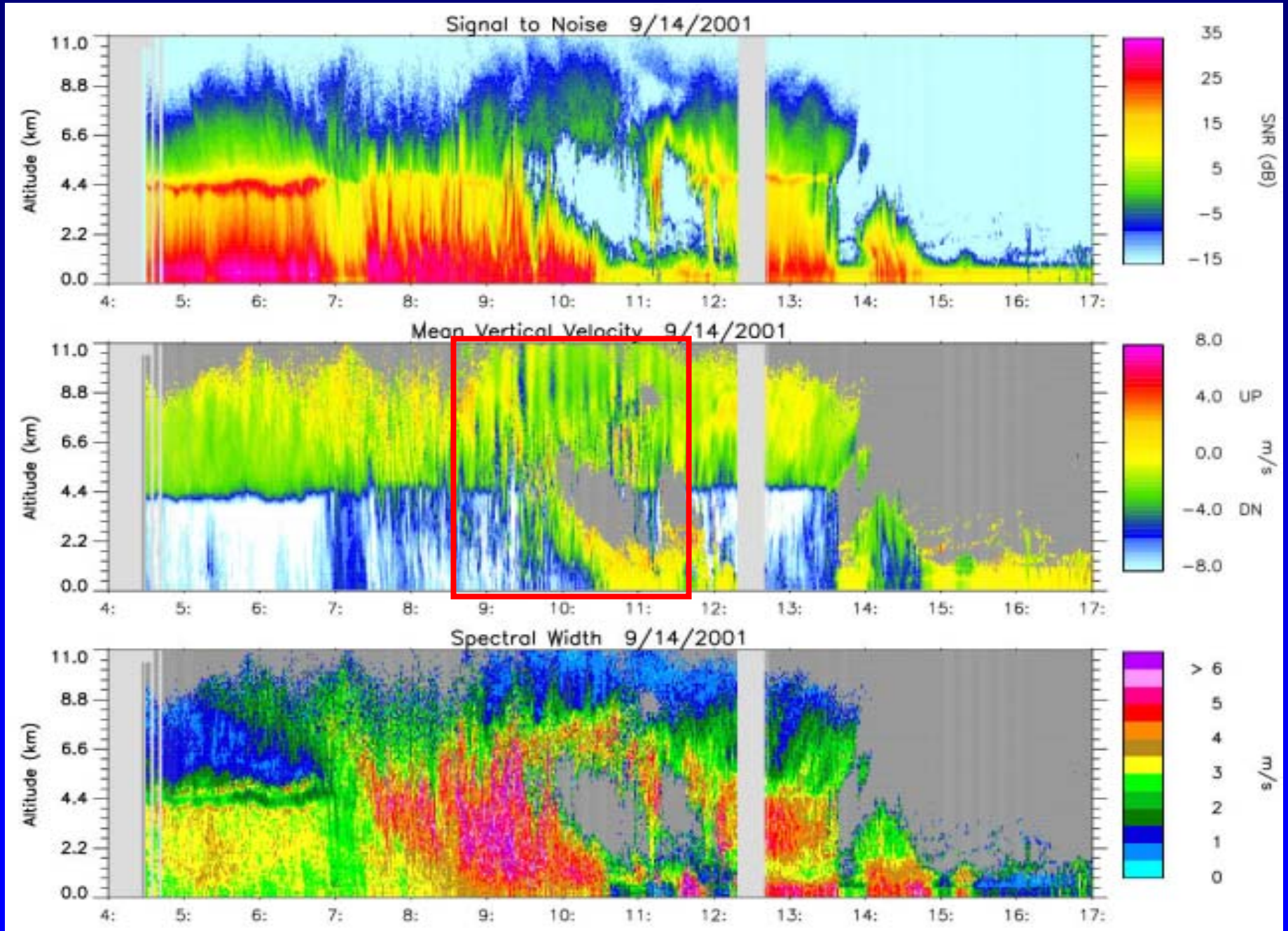
TBW, 1200 UTC

Gravity waves in the stable air

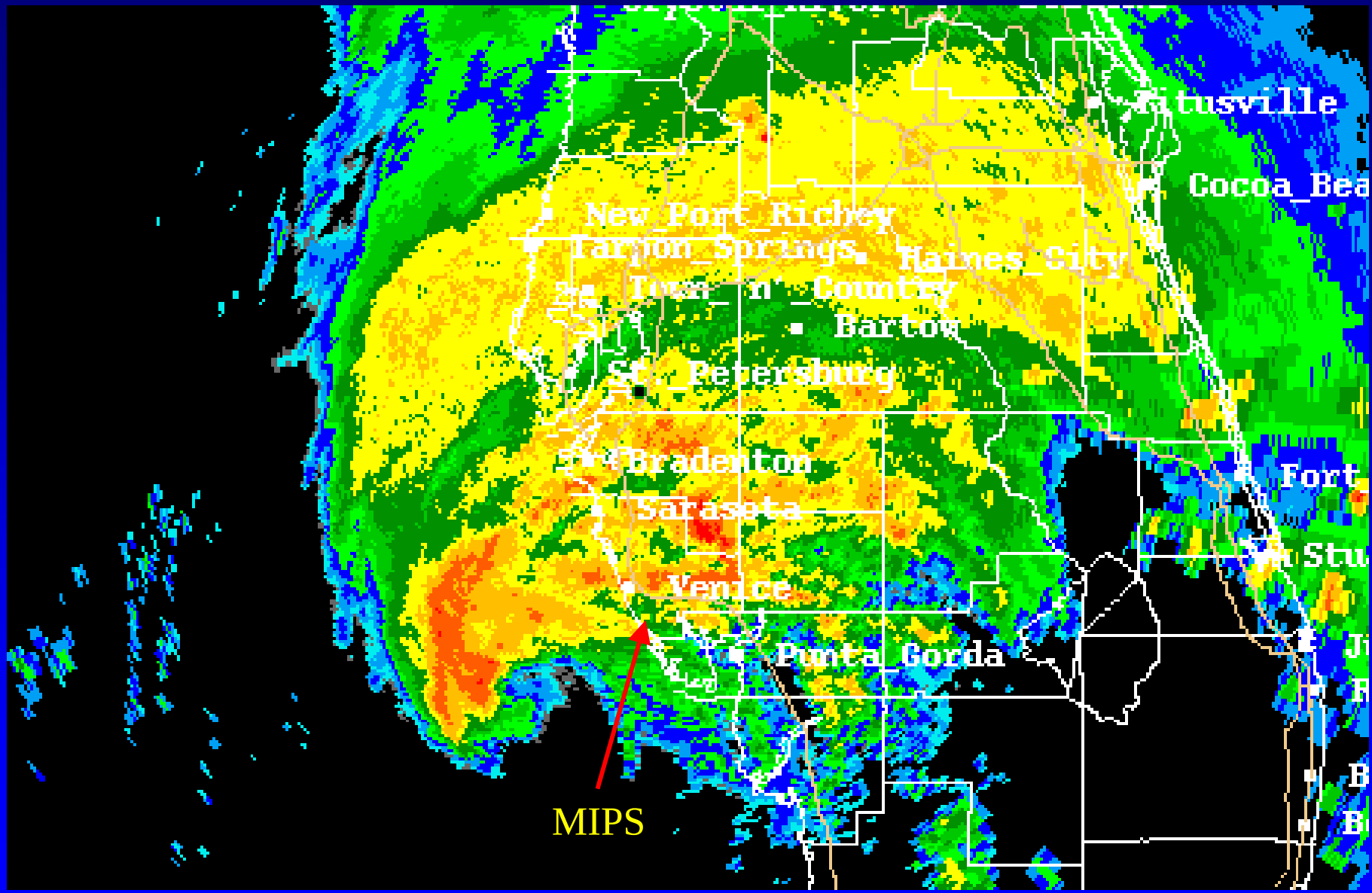




Upper tropospheric wave motions, 0840-1140

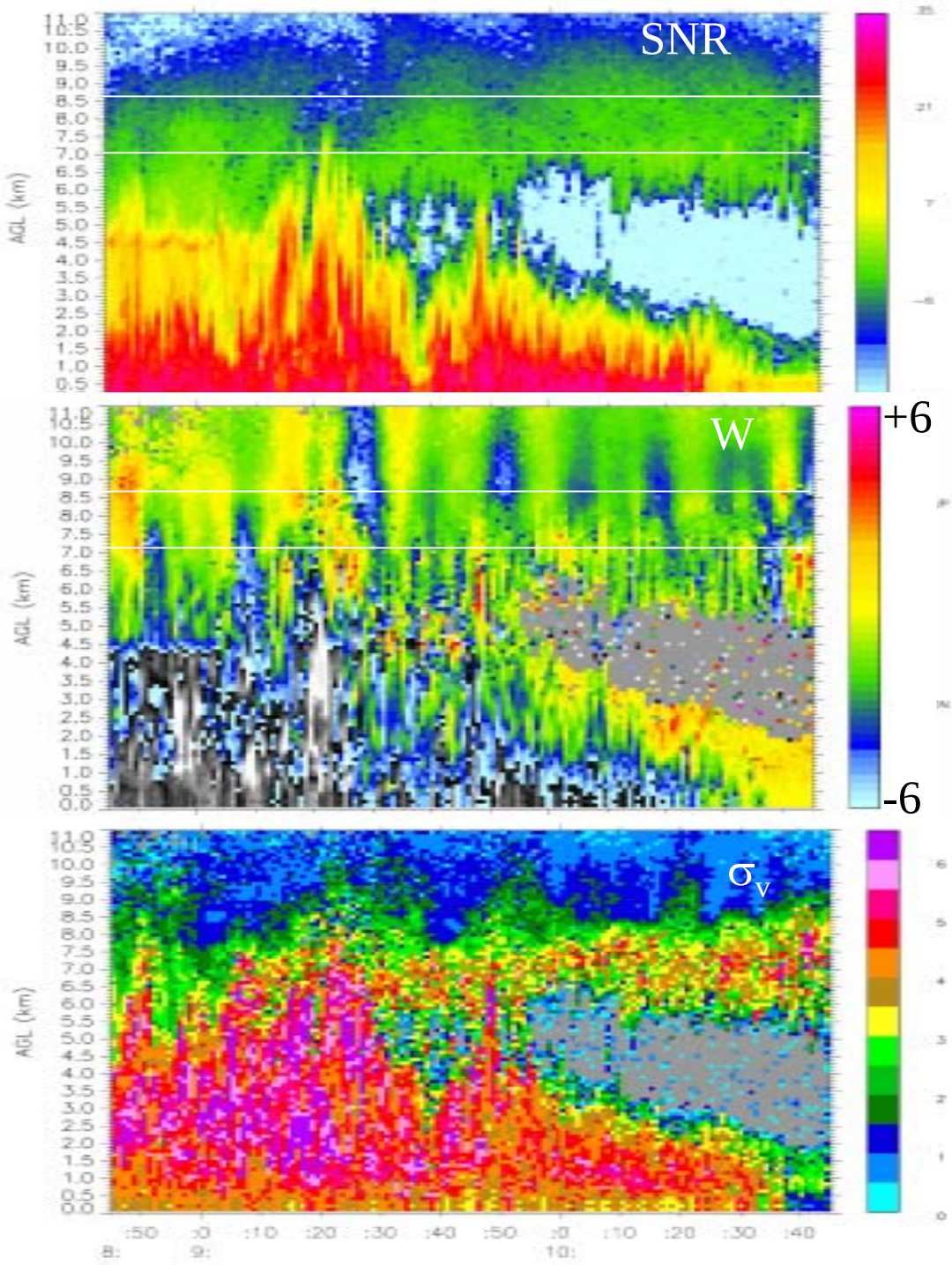


TBW 88-D, 0942 UTC

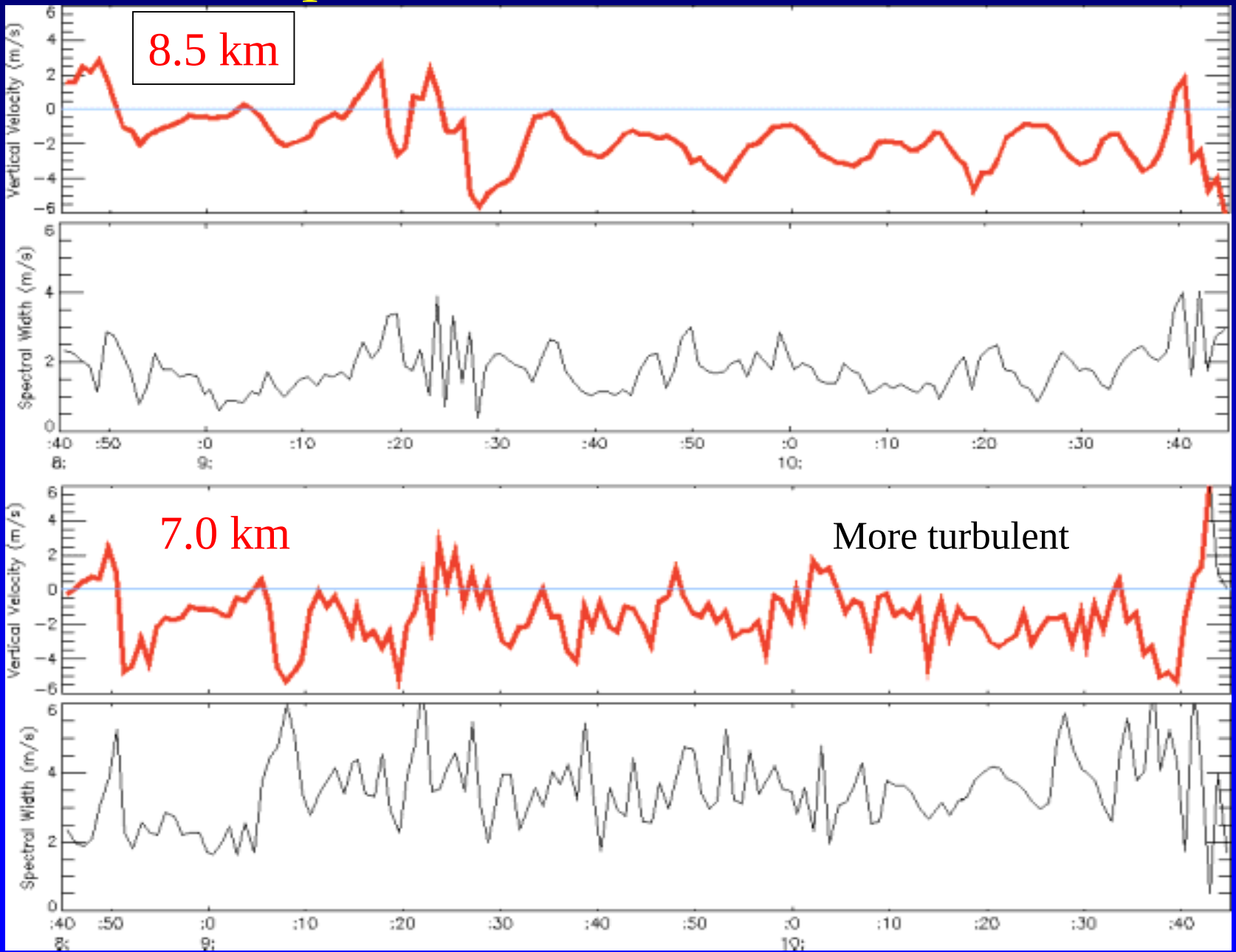


Wave motions at 8.5 km AGL near the circulation center

- Relatively uniform anvil echo (top)
- Periodicity in w (middle)
- Turbulent flow at 7.0 km, more laminar at 8.5 km (middle and bottom)

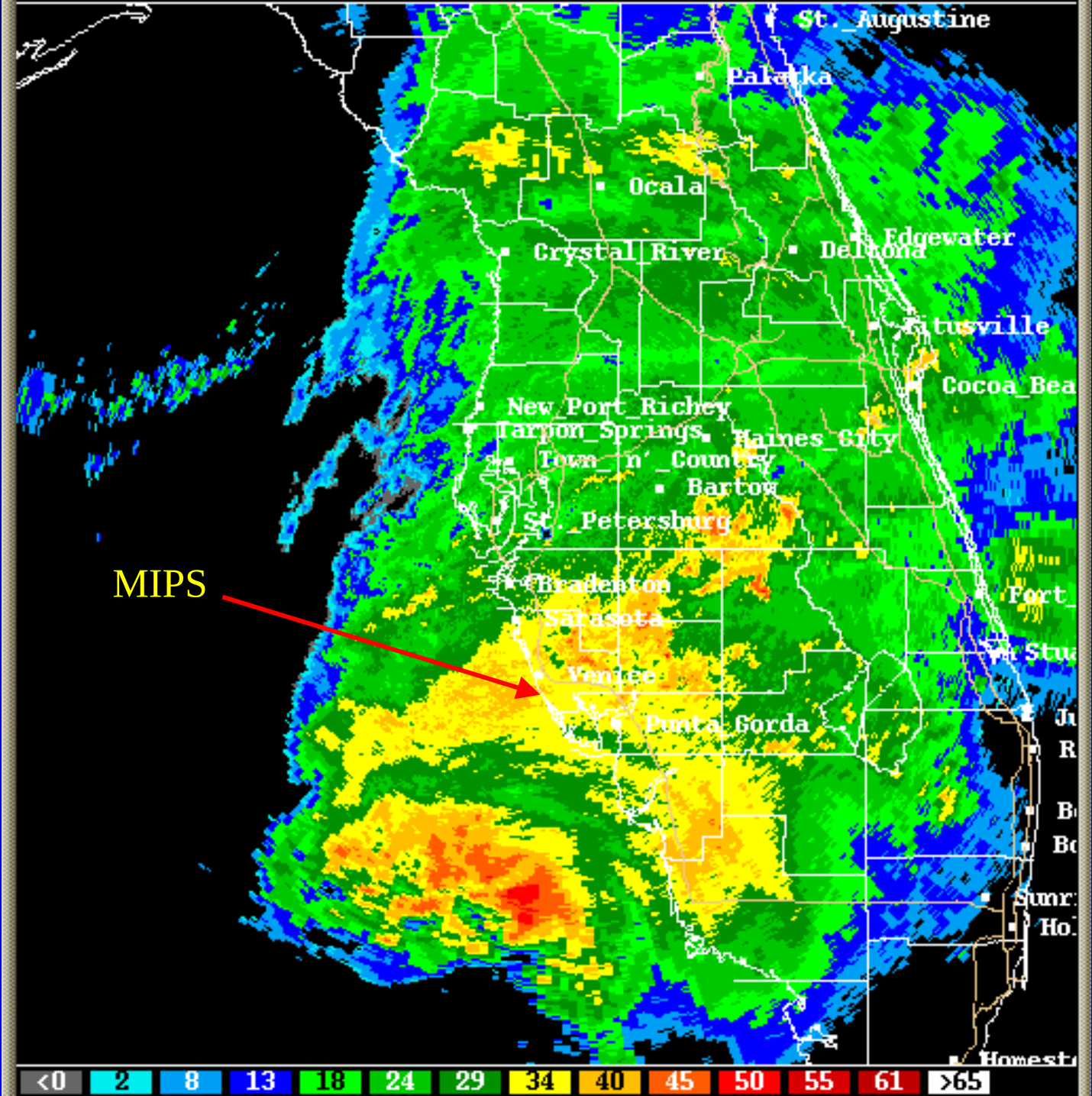


W (w+V_T) at 7.0 and 8.5 km (0940-1040)



Variability in the stratiform region

0548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Palatka
Ocala
Crystal River
Edgewater
Deltona
Titusville
Cocoa Bea
New Port Richey
Tarpon Springs
Haines City
Town n' Country
Bartow
St. Petersburg
Bradenton
Sarasota
Venice
Punta Gorda
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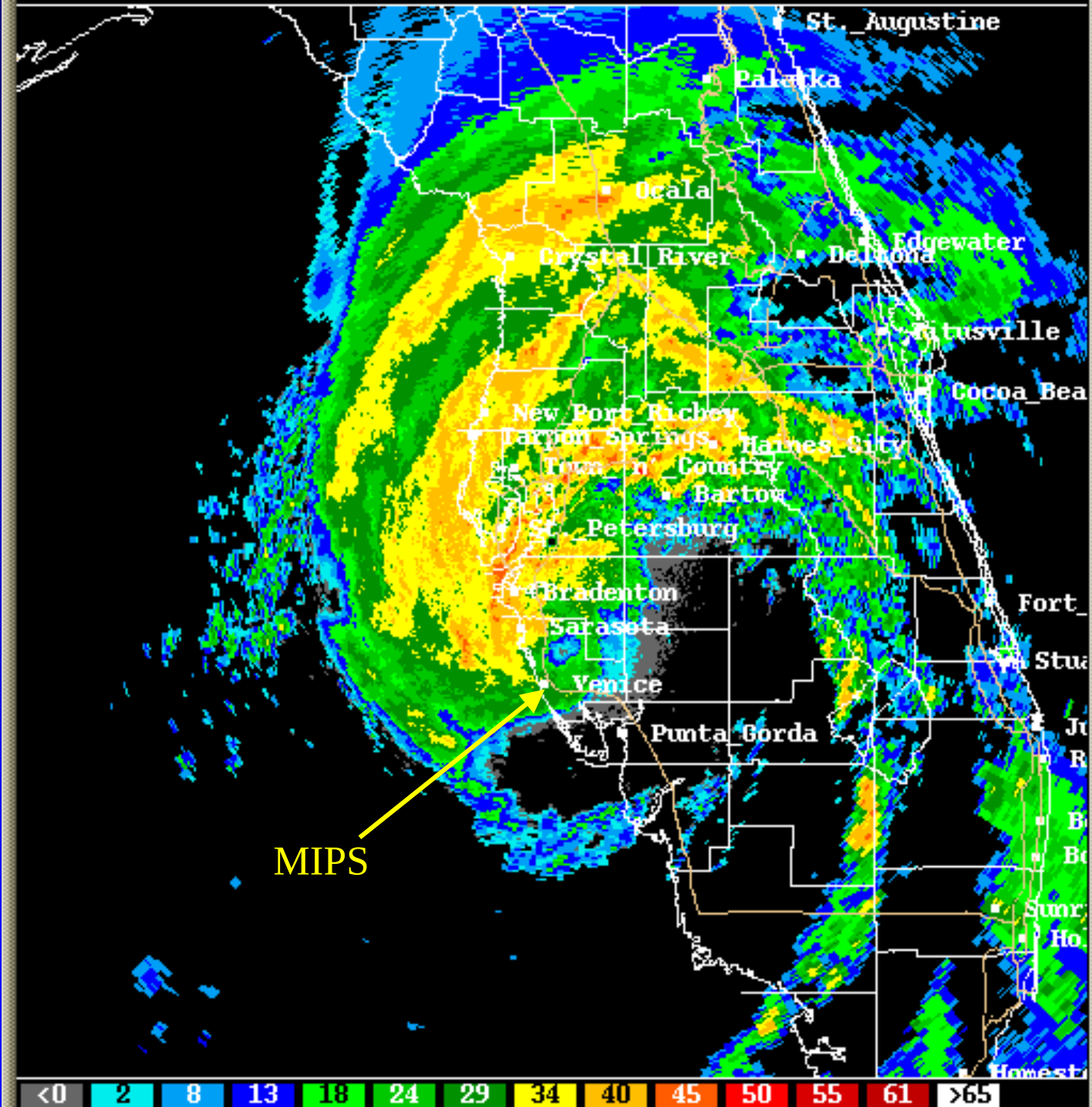
1247


St. Augustine
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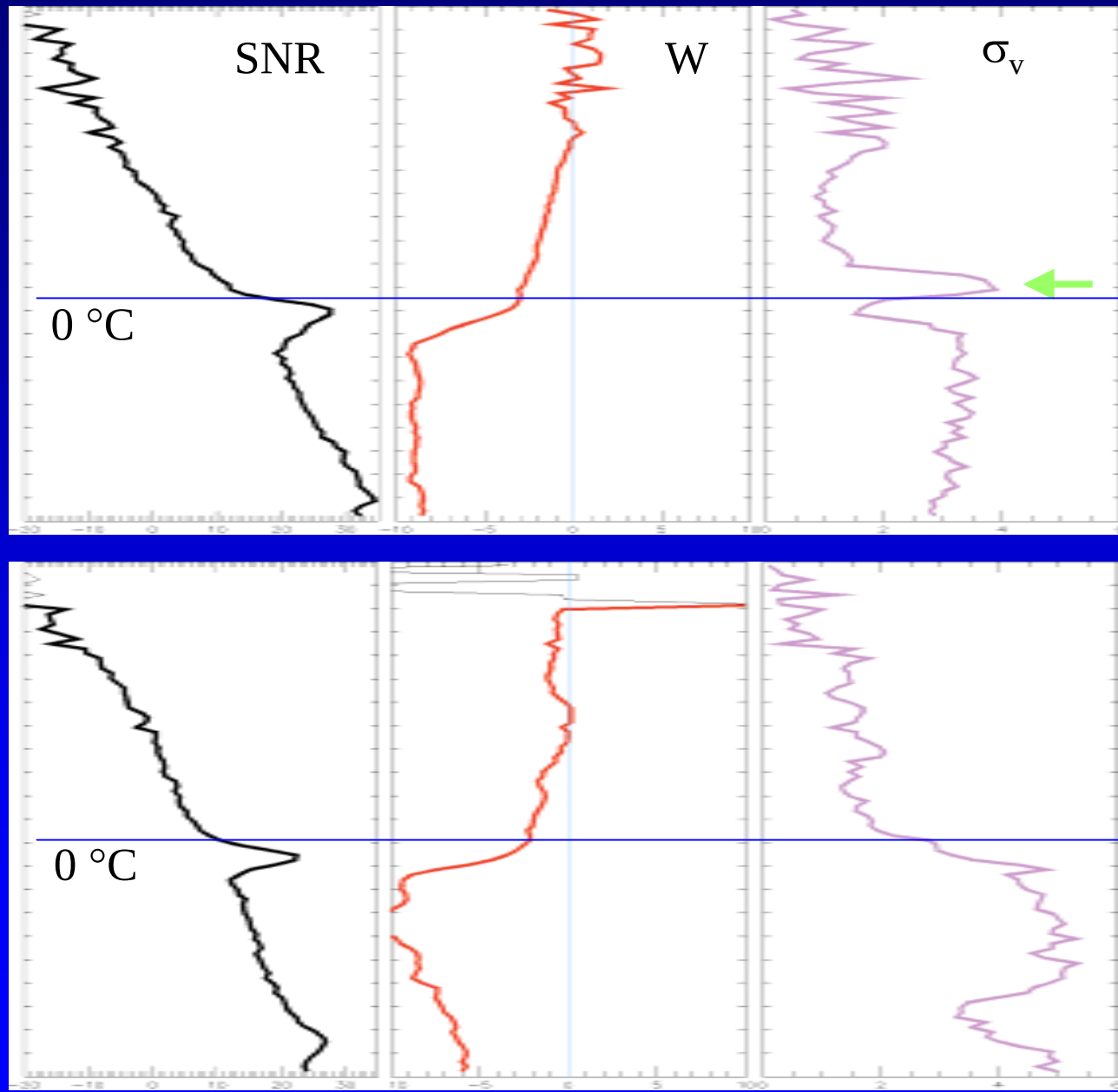
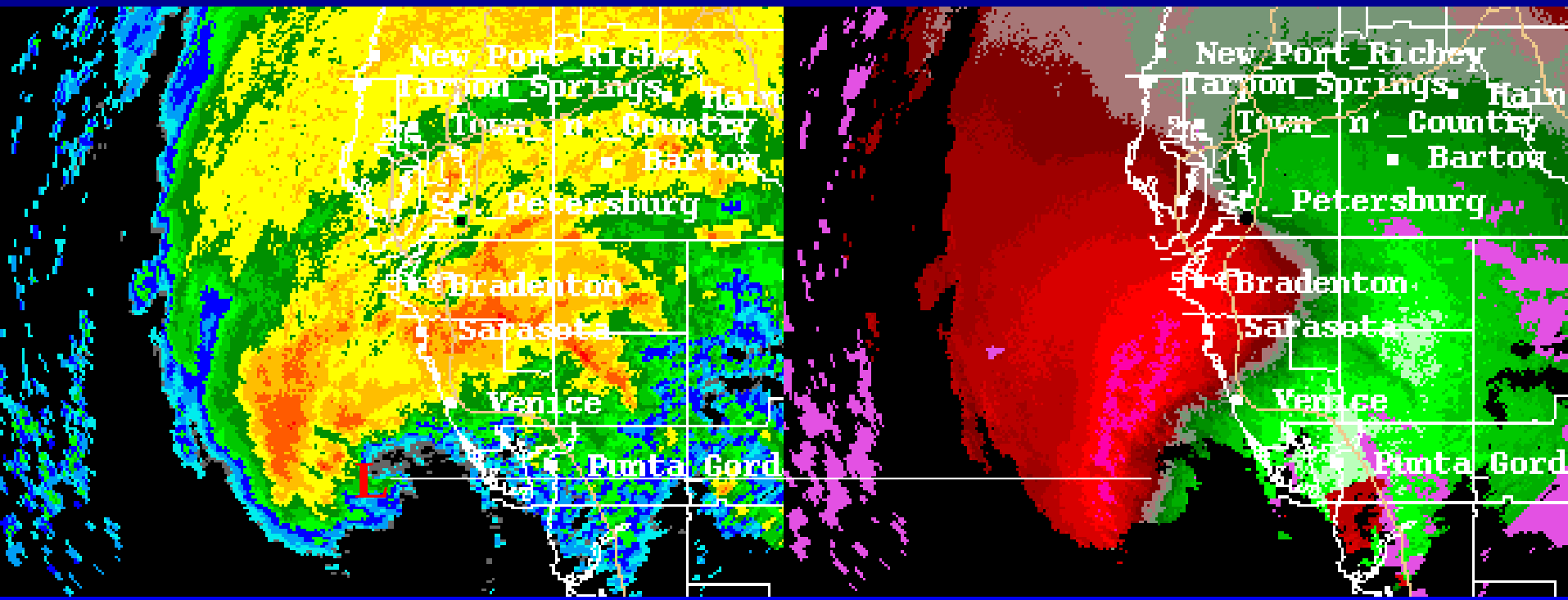
Variability in the bright band (stratiform regions)

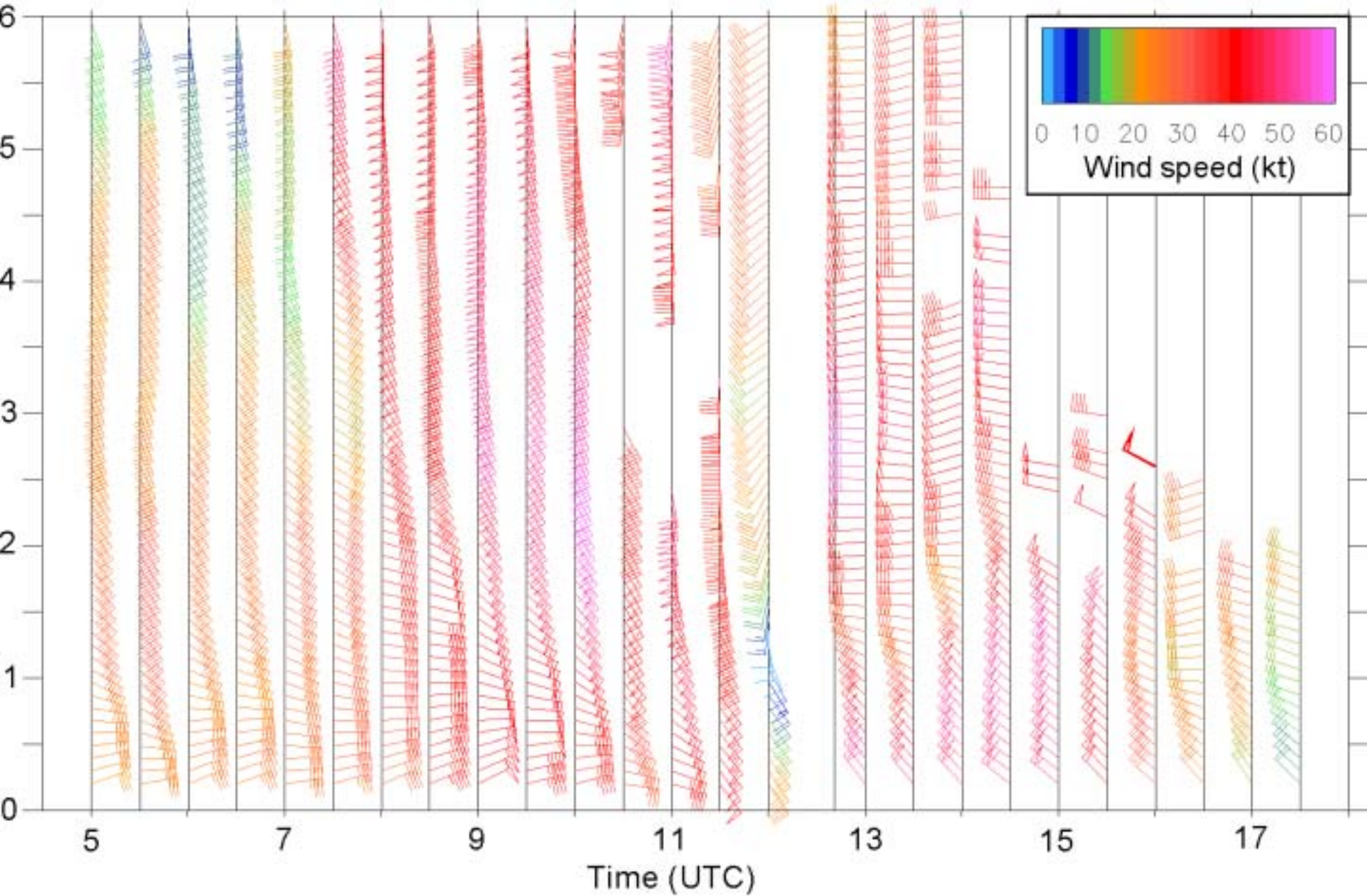
- 0548 UTC
  - thick
  - enhanced SW layer above
  - uniform V_T
- 1247 UTC
  - thin
  - greater SW below
  - decreasing V_T



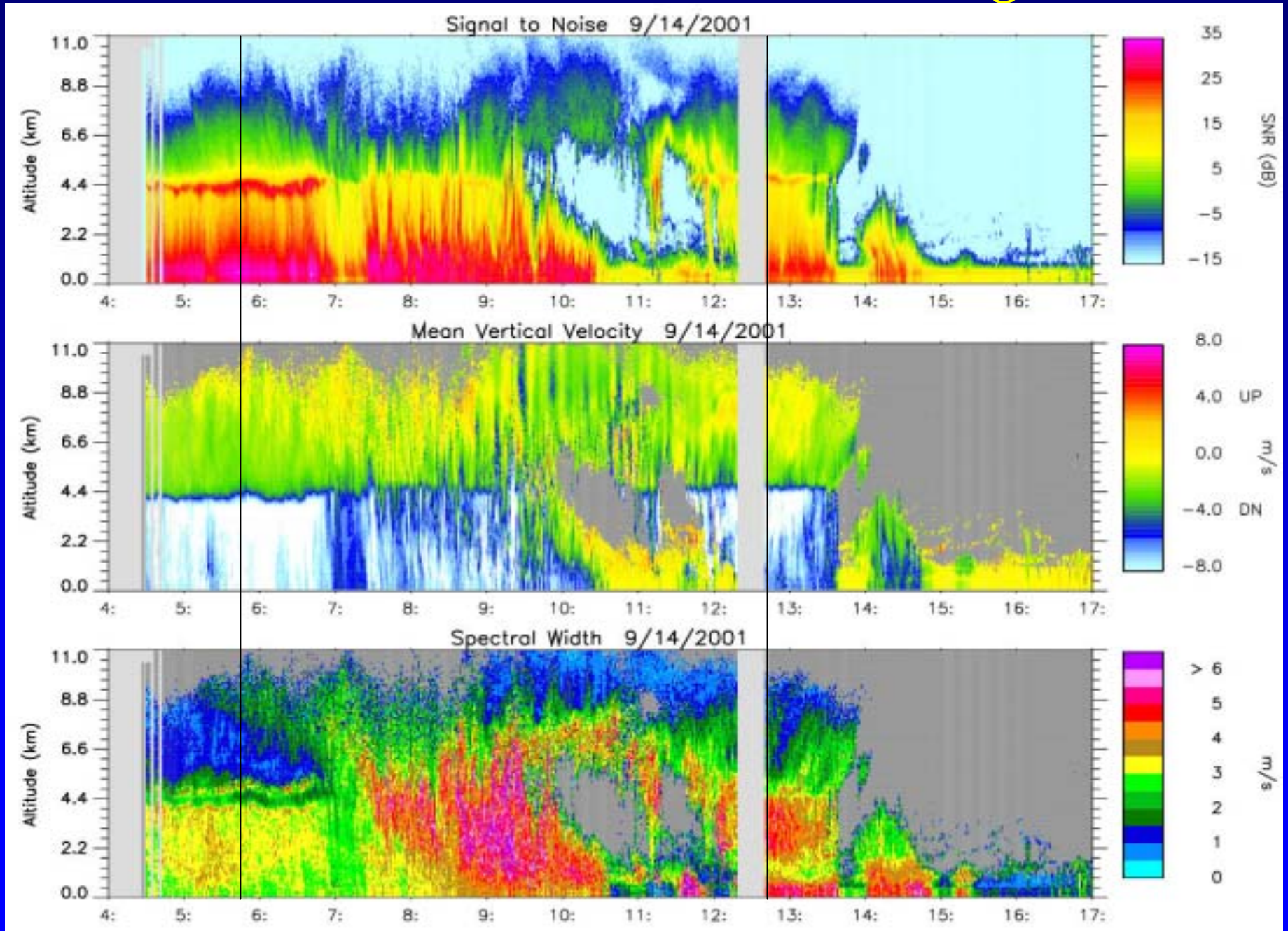
Boundaries: 88D at 1022



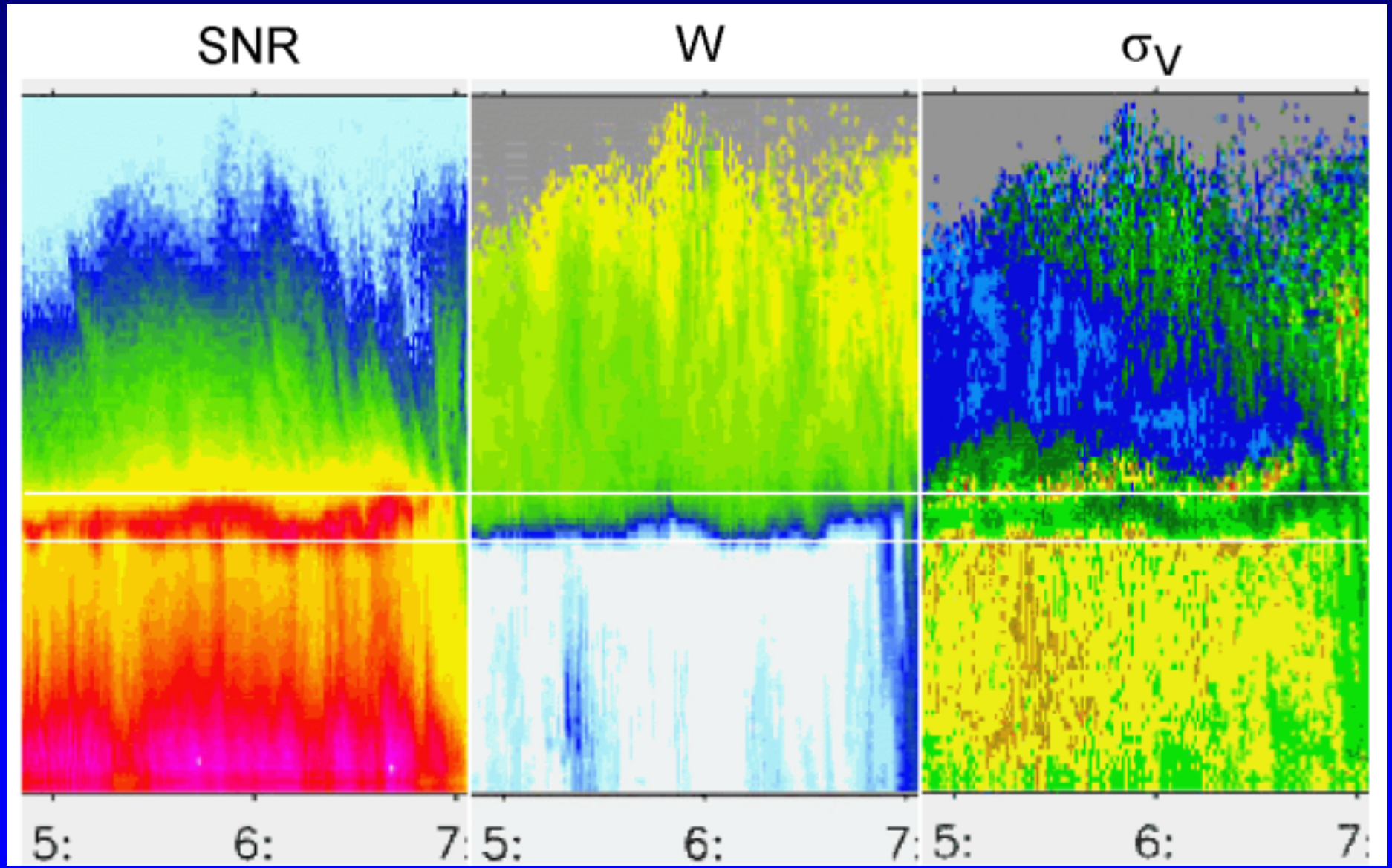
horizontal wind, 10 min average, displayed every 30 min



Characteristics of the stratiform regions



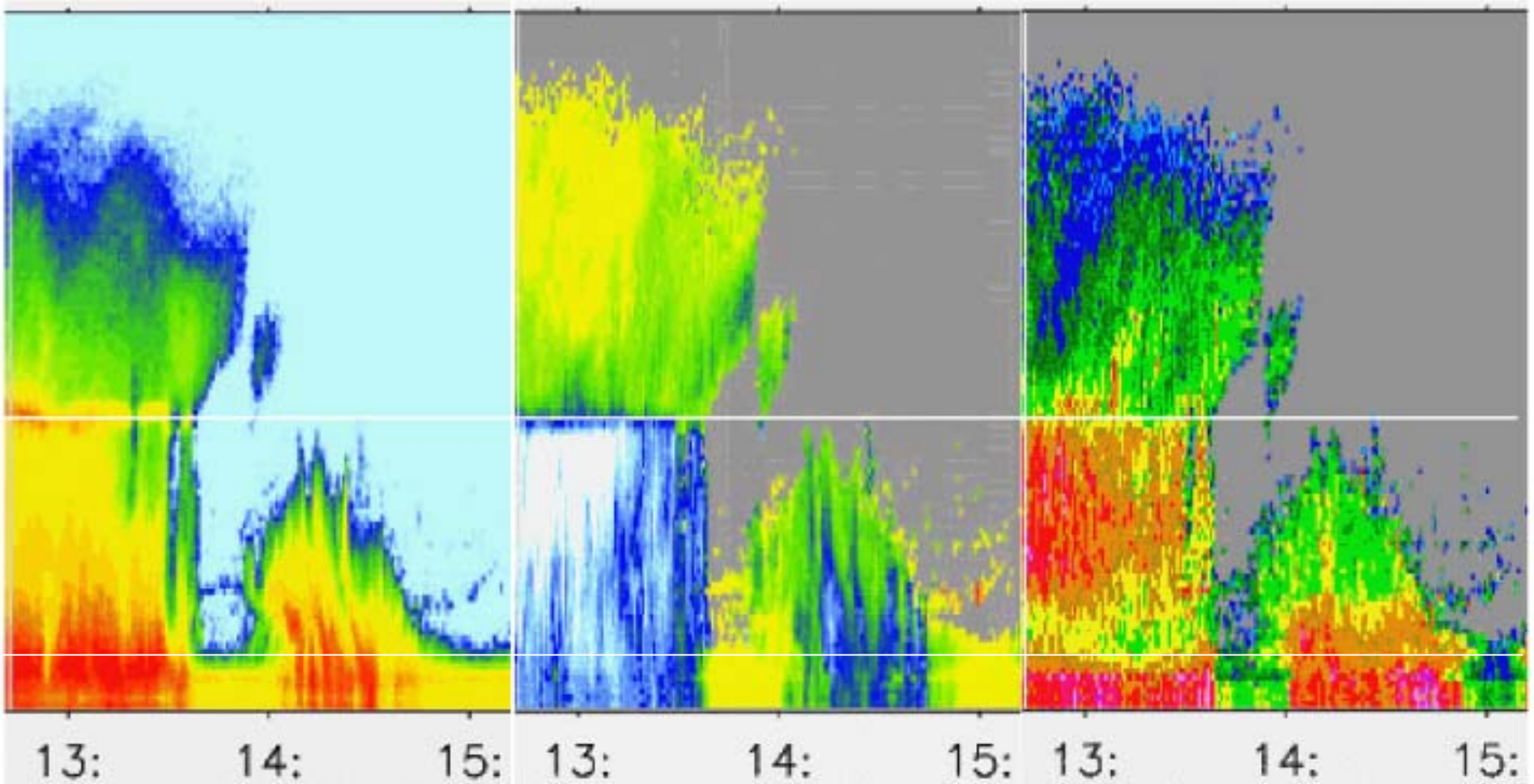
Details of the spectral moments in the stratiform region



Time (UTC)

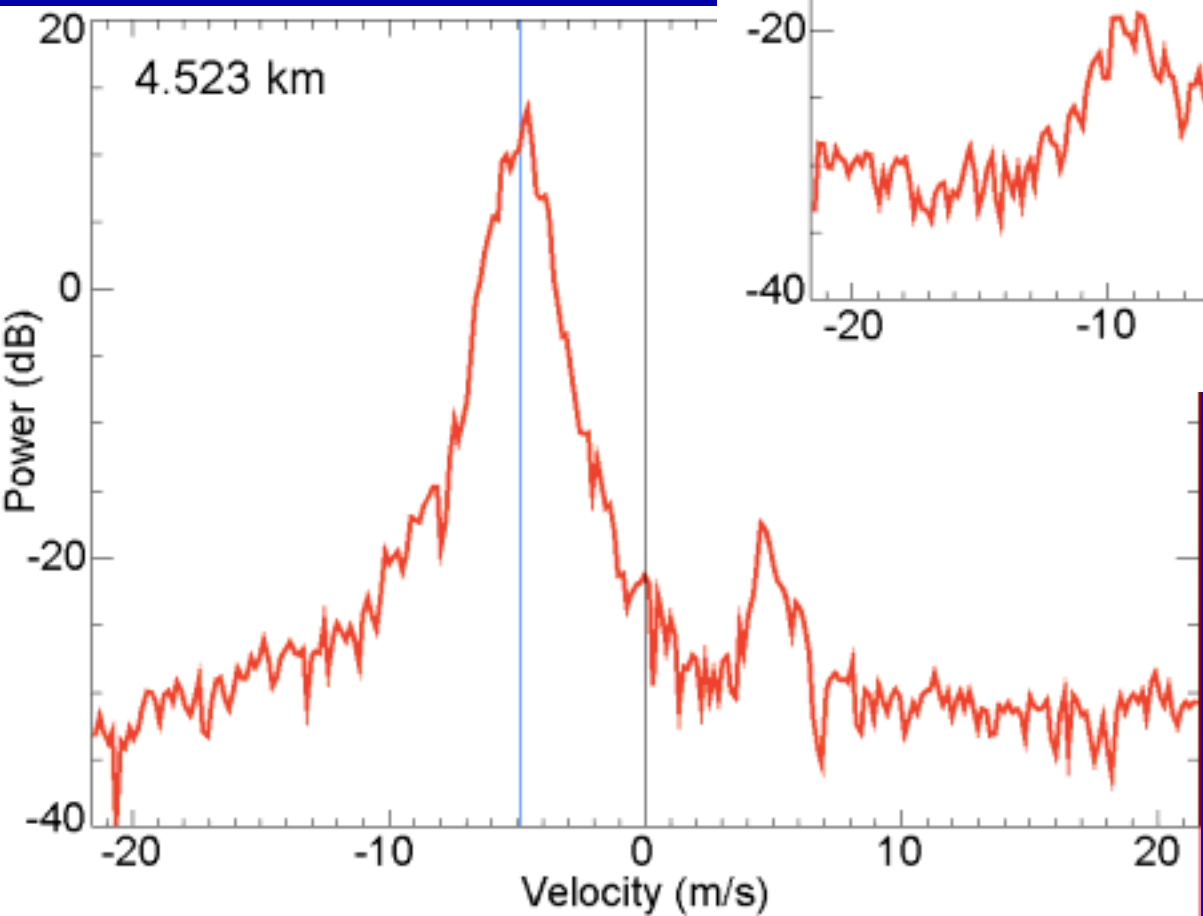
Spectral moments in the trailing stratiform region
The ABL depth is defined in the σ_v field

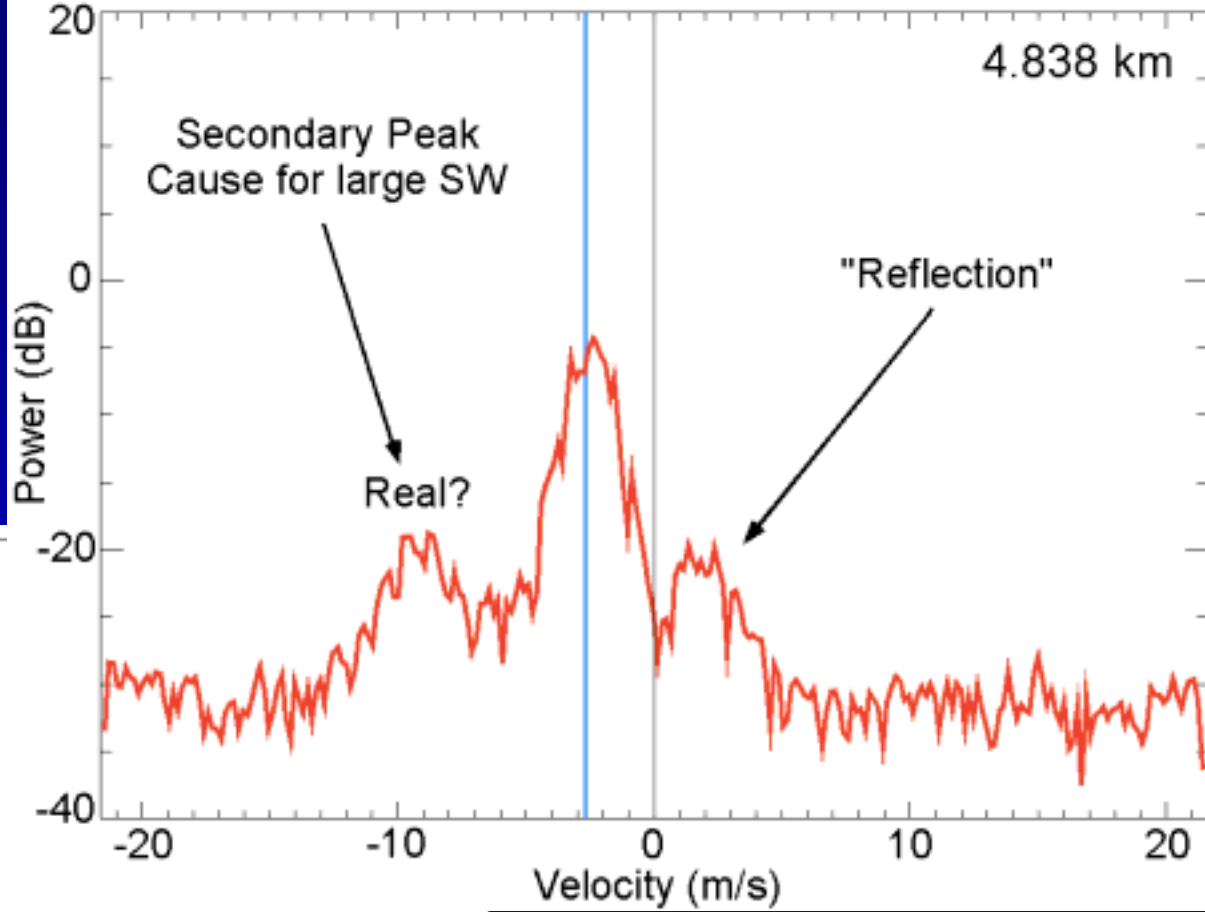
SNR W σ_v



Time (UTC)

Velocity spectra at 4.84 and 4.52 km AGL at 0548





- Above: within SW peak
- Left: within SNR peak

Some interesting features

- Electrification properties (electric field)
- Bright band variation
- Wave motions near circulation center, gravity waves in convective region
- Boundary layer variation
- Wind profiles
- Eye formation
- Frontal boundary and baroclinic features

Future work (prioritized)

- Analysis of landfalling TC/TS (collaborative)
  - Georges (MIPS, DOW, WSR-88D, P-3)
  - Gabrielle (MIPS, SMART-R, WSR-88D)

- ***CAMEX-4 does not end until the beginning of CAMEX-5. The landfalling TS/TC data base is insufficient.***
  - Additional deployments on future landfalls
    - Collaboration with NOAA/HRD and Texas Tech

End

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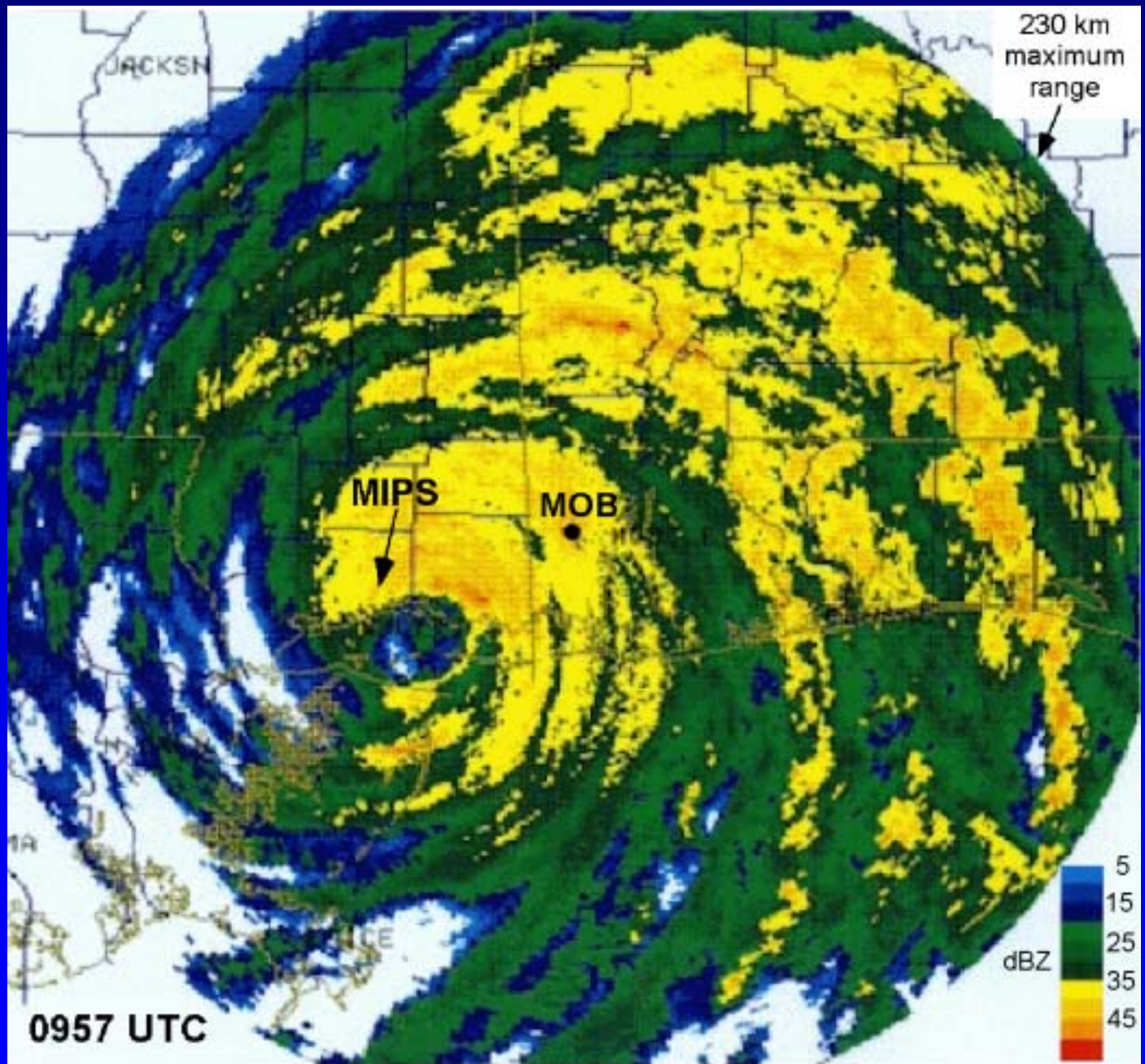
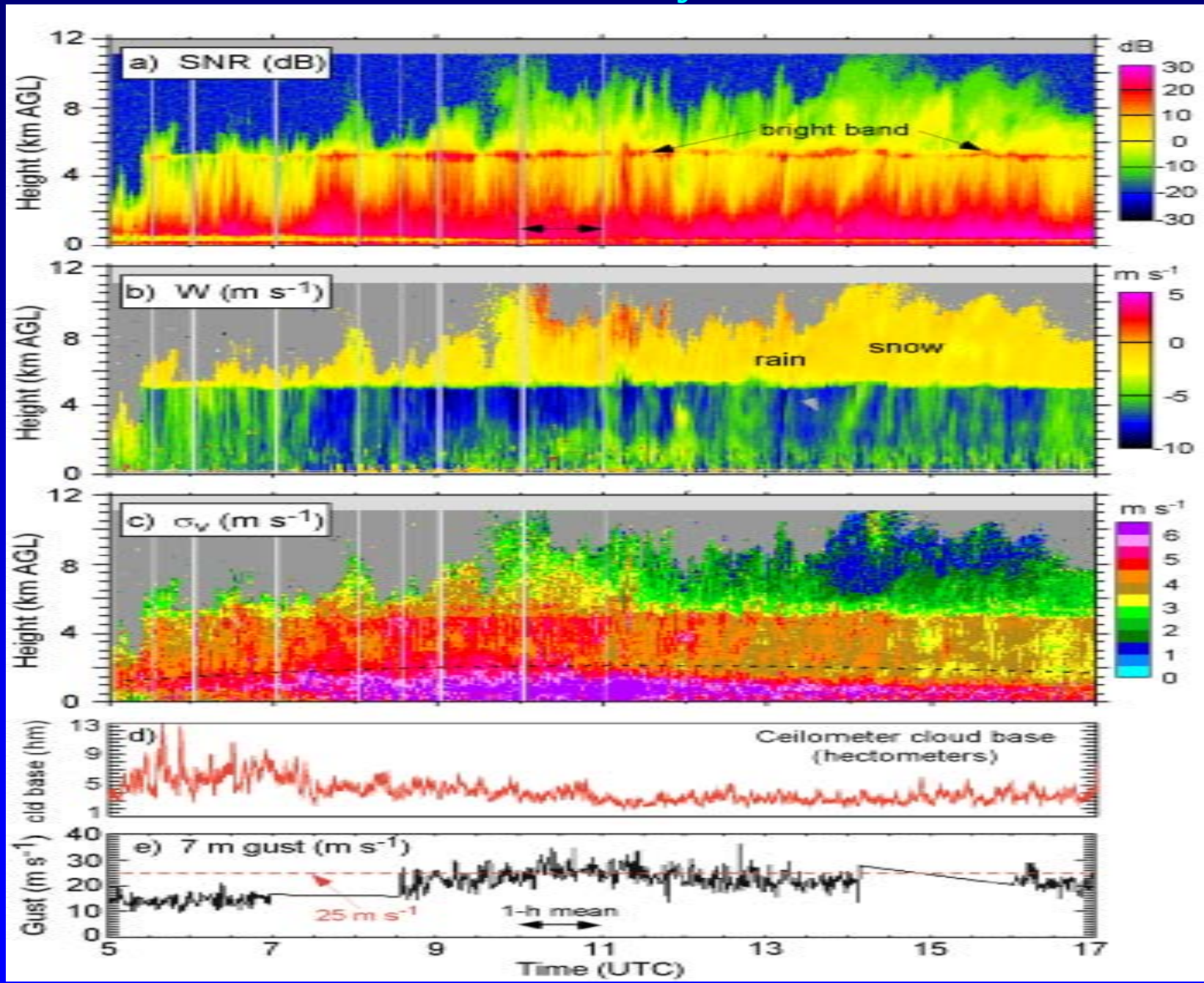
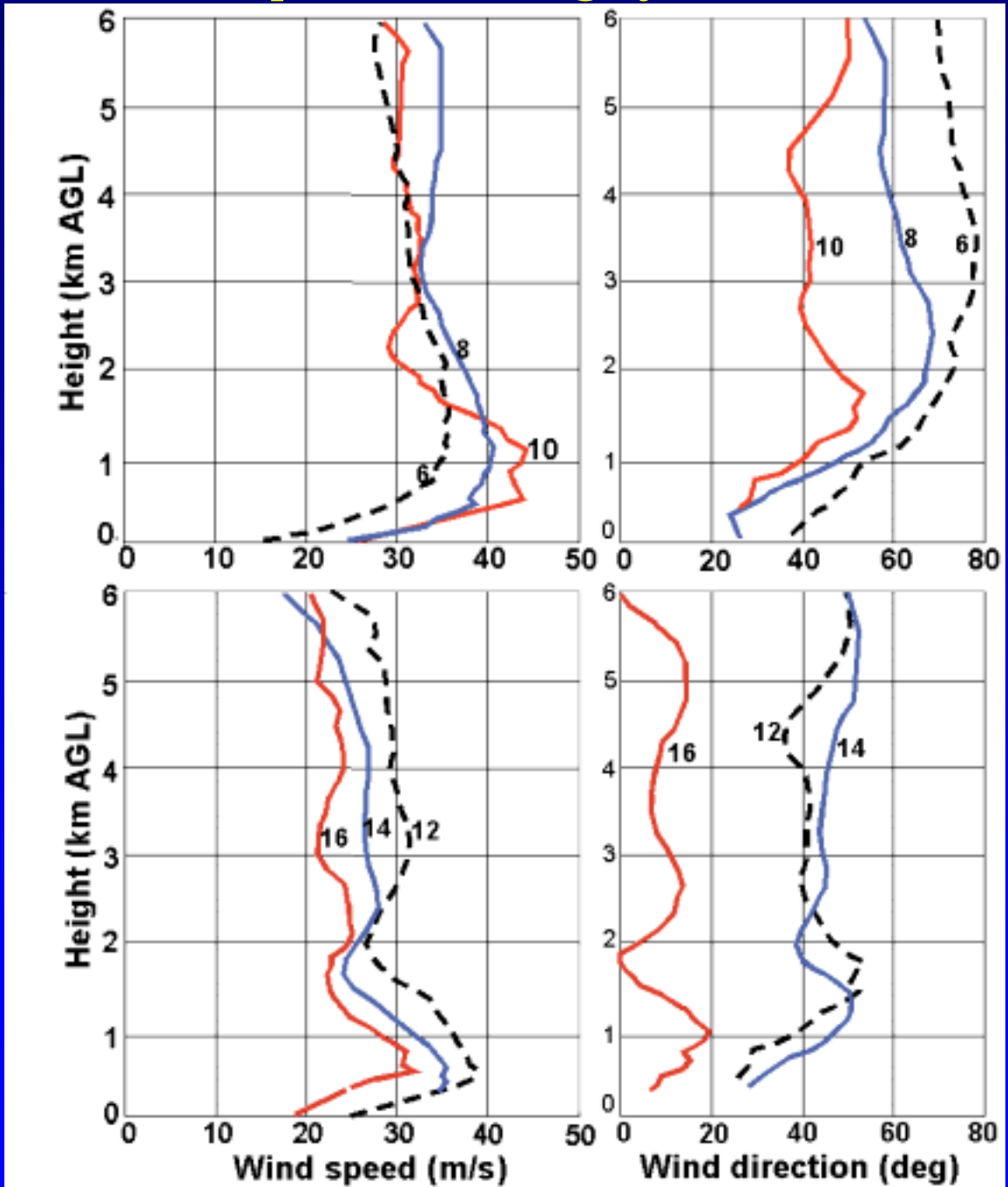
Measurements in the NW eyewall of Georges (1998)



Measurements within the eyewall, 05-17 UTC

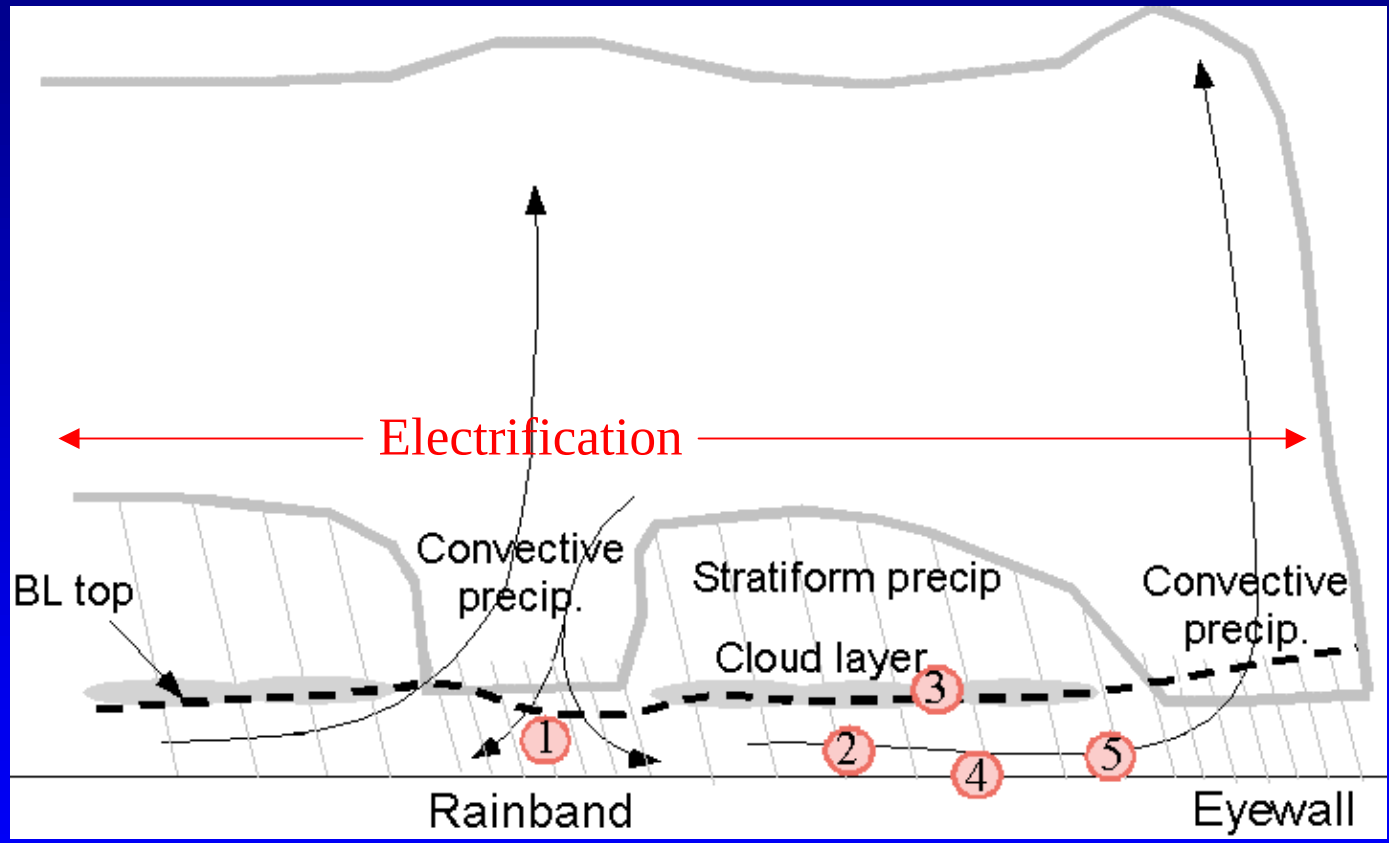


Georges: Mean wind profiles during eyewall conditions, 06-14 UTC



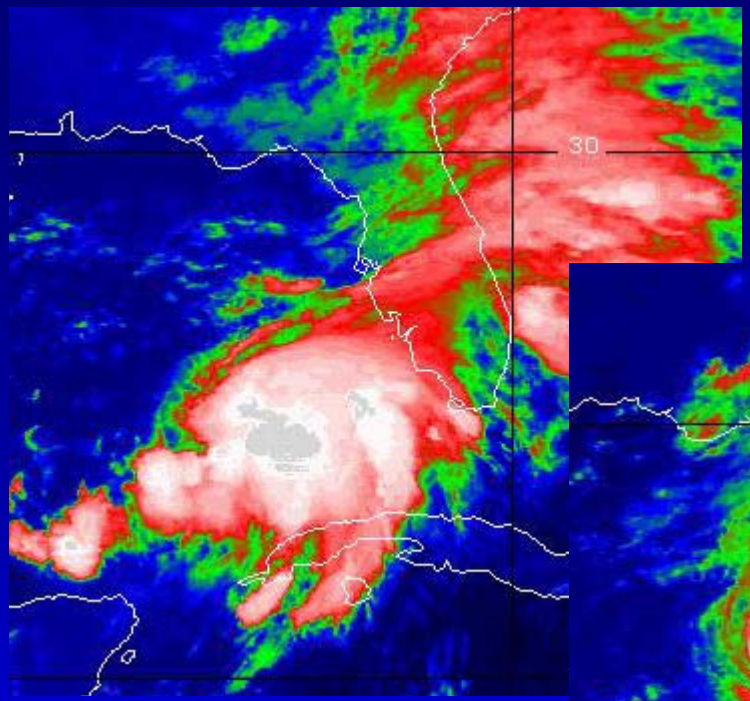
Important BL processes

1. Downdraft transports
2. Rainfall evaporation (thermodynamics)
3. Entrainment into top of BL
4. Surface fluxes
5. Shear generation of TKE

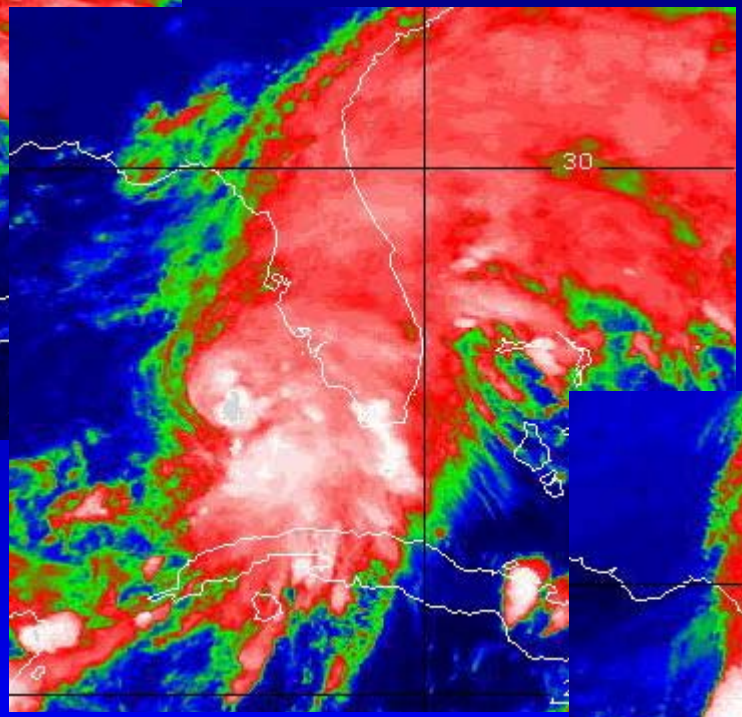


Radial cross section

GOES IR sequence at 12 h intervals beginning 24 h before landfall

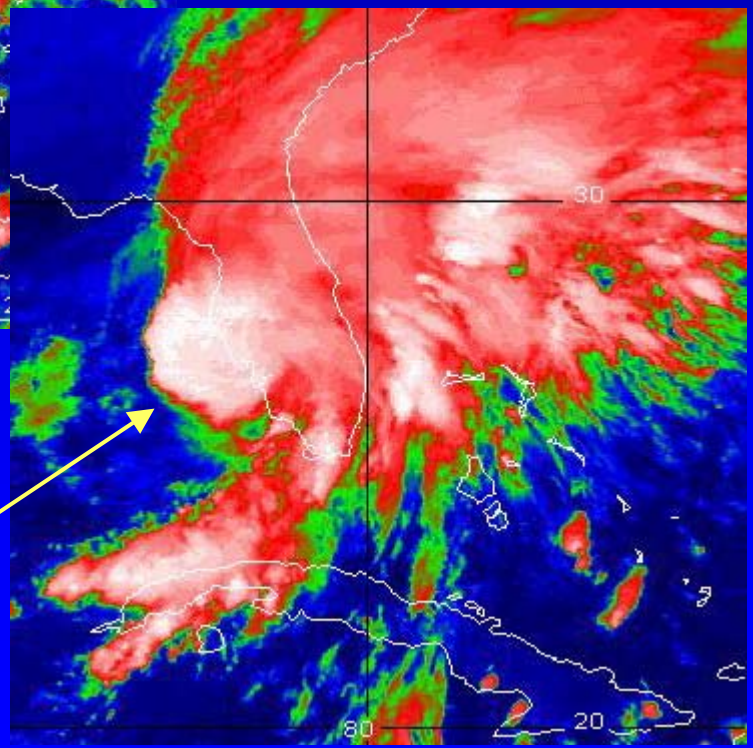


1115 UTC 9/13/01



2315 UTC 9/13/01

1115 UTC 9/14/01



40 min prior to landfall